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GAS JOURNAL

LIGHT • HEAT • POWER • BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

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VOL. CXXXVII., No. 2800.] TUESDAY, JANUARY 9, 1917. [69TH YEAR.

EDITORIAL NOTES.

Value to Industry of Science in Education.

HAVING in view the developments prompted and impelled by the war, there is no hesitation in making the categorical statement that the chemist is coming into his own. On all hands, we are a more enlightened people than (say) only two-and-a-half years ago; and our Teutonic enemies are to be cordially thanked for helping forward this enlightenment, while being as heartily detested for forcing upon the world the horrors of a war of such magnitude, together with the savagery in which they have proved themselves a highly "cultured" people. In almost every direction, industrial development points to the need of the greater union of chemistry with engineering and manufacturing processes; and we have either to accept or leave the indication—in the one case helping the pace of progress, or in the alternative retarding it, and peradventure receding farther back, leaving the faster progress to the nations that act on the lessons that the times and events have provided. In the gas industry, the whole of the developments within sight point to the chemist being a more important factor in the future than in the past, and especially the man who can claim to be both chemist and engineer. In the operations of the gas-works, the chemist has been very much regarded as occupying a position somewhere in the rear of the organization, away from the public gaze. Nothing much is heard of his work; yet its influence upon the economies and the finances of a gas-works is second to none, and has at least an equality with that of a works' or distributing engineer or sales manager. The future will emphasize this, if emphasis be needed. There are, of course, those who feign not to see this; but without the help of the chemist, some of these individuals would be let-down very badly, and particularly so in the days to come. The position may as well be recognized first as last; for events and progress are certainly going to place the chemist in a position superior to that to which ignorance, selfishness, and possibly other causes and motives have hitherto consigned him.

During the great campaign of the past two or more years in regard to post-war industrial developments and trade, there have been many searchings to ascertain why it is that manufacturers have, generally speaking, had so little recourse to the controlling and economic power of competent chemical assistance. The cause of this particular effect in negligence that appeals to us as having about it the most genuine appearance is that, as a rule, manufacturers and many of those in executive charge of large industrial undertakings have not during their educational days been made to appreciate the value of scientific aid through not having themselves rubbed shoulders with practical science—due to its absence as an element in the school curriculum. This is a mistake that there is evidence has to be, and is going to be, rectified. There should, however, be no mistakes in respect of what is required; and this is said as it is quite apparent that even among Public Schools Science Masters there are erroneous notions that have to be eradicated. At the annual meeting of their Association, at Eton College the other day, broad and narrow views on the subject were in evidence. The President is Prof. H. H. Turner, F.R.S., of Oxford University. Putting forward the view that, if more money were spent on science, more scientists would be produced, he remarked that a limit would be reached beyond which no suitable candidates would be forthcoming. Therefore the ideal of teaching science to everybody left him lukewarm. That is the narrow view. It is the view that has been responsible in the past for much of the inappreciation of, and low estimate placed upon, scientific help by the masters of industry—the men who had been denied by their schools any acquaintance whatever with science, and who, by the educational deficiency, were largely destitute of the qualification to assess properly the industrial and commercial value of science.

But Prof. Turner had the corrective applied by Mr. C. E. Ashford, the Head-Master of the Royal Naval School at Dartmouth, who, disagreeing with the preferential treatment of the select few, said his own work and aim at present consists in providing for the average boy, and letting the genius look after himself. This is the correct line. Many an "average boy" is a coming master in industry and manager of men; and it will make all the difference in the world to the chemical worker and investigator if the master and the manager are able, from their own knowledge, to measure the value of his services, and profitably utilize the results. Moreover, no harm can be done to the "genius" by Mr. Ashford's method of legislating for the "average boy," seeing that genius sometimes lies dormant, solely through the want of opportunity to germinate and to reveal itself. Everybody—including men who later are experts—must start at the rudimentary rounds of the scientific ladder. As Prof. R. A. Gregory observed in a paper on "Science for the Rank-and-File," school work should not be concerned with the training of experts in science; vocational instruction can come after. We agree; adding that vocational instruction will be made all the easier by the foundation supplied by the teaching of science as an essential element of a liberal education. Everything is to be gained by this attitude; but much is to be lost by adherence to a mistake of the past as favoured by Prof. Turner.

Higher Maximum Prices for Sulphuric Acid.

SULPHATE of ammonia makers will not view with any pleasant feelings the addition to the maximum prices for sulphuric acid, as this means an increase in their sulphate manufacturing costs, while prices are fixed for home consumption. However, we understand that some very strong representations have already been made by the Chairman (Mr. D. Milne Watson) and the Committee of the Sulphate of Ammonia Association to the proper authorities. It seems somewhat unreasonable that upward changes of this kind should be made without any conference with all the parties concerned; and, in this instance, there does not appear to be sufficient cause for the increase, in view of the excellent profit that the maximum prices fixed in February last year gave to makers of acid, and which, so far as we can see, well cover any fluctuations in costs that have since occurred. It is quite true that pyrites is more difficult to obtain, that the prices of pyrites have increased somewhat, and that there is a shortage in the supply of sulphuric acid, while makers of sulphate of ammonia have not taken kindly to the partial use of nitre cake. But these reasons are insufficient in face of the maximum prices that were fixed last February. The new maximum prices are quoted in another column. The prices of 70s. for Class "A" arsenical acid, and 85s. for Class "B" non-arsenical or dearsenicated acid are 10s. more than the prior maximum figures; while the price of 130s. for Class "C" arsenical acid is 15s. more, and the 140s. for Class "D" non-arsenical or dearsenicated acid is 20s. more. Class "B" acid is at present, under the controlled prices, from 55s. to 45s. more than the 30s. to 40s. which represented market values before the war. In other words, the price for this class acid has gone up 150 p.ct. more or less according to the pre-war price taken. If there is to be real national value in Government control, then

nothing appears to have occurred that, having in view the character of the former maximum prices, in any way warrants their disturbance. What some of the Government Departments are doing is to try to please everybody; and in this there is bound to be (as there is) failure. What they ought to try to do is to hold the balance evenly between all interested parties and the various conditions affected. This has not in the present instance been done, with the greater part of sulphate of ammonia selling at home under agreed fixed prices, while only a relatively small part compared with pre-war exports is being dealt with abroad at unrestricted prices.

The Professorial Accuser.

HARDLY had the print got dry reporting the Nottingham utterances of Prof. H. E. Armstrong on fuel economy and the sinfulness of the gas and electricity industries (of the Nottingham Electricity Department in particular), than this volatile individual was busy upon a further article for "The Times Trade Supplement," in which he again lectured the technical men of the gas industry, warned them as to the probable effects of their evil ways, made invidious comparisons of our unscientific fundamentals with the so-called scientific ones of the electricity industry, praised the hygienic virtues of gas, its relative safety and its economy, but advertised its destructive influences, and wound-up by asking for the intervention of a State-appointed body, apparently to save the gas industry from itself. The article forms a strange mixture. "The gas industry has hitherto "rested on a bed of empiricism." There are active beings outside the gas industry who can, in respect of some of the subjects upon which, without practical qualification, they speak dogmatically, be classed as empirics; and it is unnecessary to seek far for an illustration.

The article has for its title a question: "Can Coal Gas "Survive as a Lighting Agent?" We gather that it can, if the persons who have so far guided the fortunes of the industry, and who in his inmost soul Prof. Armstrong apparently regards as a lot of idiots, are utilized for less important work, and men of greater scientific attainments are put in their place. The industry must, he thinks, find salvation by being reconstructed, and put on a higher level. But this, we are told, will never happen while directorates are, for the most part, composed of business men and lawyers. What is required is a greater leavening of directorates by men with technical qualification. While agreeing with the inclusion on boards of directors of men of technical knowledge of the industry, and while charging Prof. Armstrong with being very ill-informed as to the number of such men to be found on the governing bodies of gas companies, we fail to see, looking at the matter from the point of view of the Professor, what good their inclusion would be, seeing that they are of the very men—"the men without scientific "instincts or training, who cannot appreciate the very nu- "merous considerations that are to be taken into account" —who have, through their technical achievements, brought the industry to the present (according to their academic critic) dire pass. However, the present conductors of the industry, who are not much moved by the repeated vapourings of the Professor, will be interested to know that his solemn view is that, unless great changes are made in the management of the industry at large (there are just a few specially intelligent companies), the position of gas as a lighting agent will, in all probability, be largely sacrificed, through the failure of those engaged in it to understand and grapple with the problems that it presents. This lack of confidence upon the part of the Professor is why—gas being an indispensable fuel, and the probability being but slight that the public interests in regard to it will be properly developed under the present private adventure system—he considers the agency of some State appointed body is necessary to undertake experimental inquiries into this side of the fuel problem, in conjunction with the others. The gas industry would not in the least shirk inquiry, provided (the industry regards this as important) it was conducted by competent men wholly free from quackery.

The gas industry is placed by its critic in contrast with the electrical industry; and again he illustrates his own penury in qualification for the *rôle* that he has undertaken. From its birth, we are told in effect, the gas industry has been divorced from science, and so has suffered, while the electricity industry has "from the beginning" been conducted upon strictly scientific lines. The foundations of the latter "were laid through scientific research, conducted "solely with the object of adding to the sum of human "knowledge." It also "rests on a basis of mathematics— "the highest mathematics." The electrician, too, measures everything; and he knows at all times exactly what he is spending and what he is earning. We suppose all this explains why the electrical industry is just now talking so much of the need for reconstruction and reformation. We also suppose this is why we have had instances lately of electricity generating stations whose fuel "economy" is variously represented by a consumption of coal running from about 3 lbs. to 14 lbs. per kilowatt-hour generated. Has the assertive Professor calculated-out the thermal efficiency of the generating work of the scientifically based and mathematically correct electrical industry, compared with the processes of the (by this critic) much maligned gas industry? Has he calculated out the B.Th.U. to be obtained from the gas derived from a ton of coal, from the 10 cwt. of coke produced for sale and from the yield of tar? Has he constructed a balance-sheet showing the credits in production from a ton of coal treated on a gas-works and from a ton of coal as treated in the electricity generating-station with foundations composed of scientific principles? If not, it is time he improved his information. Has he ever studied electrical tariffs—the fixed price, and the rateable value ones especially—as well as the relation of existing electric power, heating, and cooking charges to the principles that were originally applied as scientifically correct in determining charges for electricity supply? He should study these charges in the light of the basis of the "highest "mathematics." He may then still further improve his knowledge of things as they actually are, and not of things as he fancies they are.

The only part of Prof. Armstrong's article that can be approved is that in which he indicates that he has carried his reading, if not his personal investigation, into channels that have in most respects put him on the right track as to the relative positions of the two illuminants in the matter of hygienic properties. He talks of ultra-violet rays. He does not, however, point to the magnificent preponderance of these hurtful rays in electric light over incandescent gas light. He omits to mention the still more harmful intrinsic brilliancy of the electric light in contrast with incandescent gas light. He mentions special glass as counteractive of the ill-effect of ultra-violet rays. The mass of the people cannot afford special glassware at every point of lighting; and, therefore, the light that is the least injurious in these respects is the one that should surely be the more generally adopted. He agrees that the cost of production per unit of light is greatly in favour of gas; but he says that "probably" there is no great difference in the cost of installation and upkeep of the two systems. We advise him to go into details. Gas, too, has proved safer in regard to fire; it also sets up air currents, and prevents stagnation of the atmosphere, and so a better distribution of gas is obtained. But he finds there are sulphurous and sulphuric acids given off, which have a pernicious effect on bookbindings, furniture, &c. The whole of the sulphur compounds, therefore, want clearing from the gas. So thought other chemists; but Lord Rayleigh's Committee were not persuaded. Instead of generalizing in this matter, perhaps Prof. Armstrong will supply some actual data procurable from his researches—prefacing what he publishes by a study of an article on p. 570 of the "JOURNAL" for Nov. 18, 1913; and two others by Mr. W. J. Atkinson Butterfield which appeared in the "JOURNAL" on Sept. 14 and 21, 1915 (pp. 568, 636). He may perhaps derive some advantage from his reading.

Economy in Laboratory Methods.

SOME of the old-established laboratory methods of conducting tests, to which methods generation after generation of chemists have become habituated by their perpetuation in text-books, badly want dislodging. Many of them are time-wasters; and in large industrial establishments, especially those like gas-works (the whole of the manufacturing operations of which call for chemical control), the chemist has no time to waste. He must therefore economize as much as possible in the time occupied in carrying out each one of his multifarious operations. Among works' chemists there are many inventors—men who (like Dugald Clerk, who, as an assistant, invented a little motor, running by the water-power supplied by a tap, to save him the personal labour of using pestle and mortar) have found ways and means of

performing tests far more expeditiously than can be done by the more or less ancient laboratory formulary. It would be of great service to laboratory operations if the fruits of the work of these men could be brought together, so as to assist generally in economizing time; for the present and prospective increase in the duties of works' chemists—at any rate, those on gas-works—calls for all the time-saving that can be effected without loss of efficiency in result. Among those gas chemists who have often been struck by the lengthy operations sometimes employed in the laboratory to bring about the fusion, solution, and combustion of certain substances when it has been necessary to subject them to partial analysis, is Mr. J. Hewett, of the South Metropolitan Gas Company, who read a paper last Friday, before the London and Southern District Junior Gas Association, on "Com-"bustion Methods in the Laboratory." The paper will be found extremely useful to gas chemists, especially in connection with the estimation of sulphur in coal and coke, as well as of iron and alumina in new and spent oxide, by means of sodium peroxide in a gas-tight nickel crucible. Already several gas-works' chemists are using the fused mass dissolved from the nickel crucible of the Roland Wild calorimeter (after the estimation of the calorific value in coal, coke, or breeze) for the estimation of the sulphur by dissolving the mass, adding hydrochloric acid, boiling, and precipitating-down with barium chloride. The results obtained are quite satisfactory; and the time-saving is considerable, compared with the old methods—using a fusion mixture and heating gently (Nakamura's method), or Carius' nitric acid method as referred to by Mr. Hewett. The range of utility of the method advocated is large; and, in availing themselves of the range, gas chemists will in several ways find the paper very informative.

De-badging Gas Men.

An important statement regarding the de-badging of gas men has been received from the National Gas Council. We will not here traverse the contents of the document, which up to a point will serve to allay the fears that have been engendered by the issue of a circular calling-in the badges from all semi-skilled and unskilled men employed in the industry. The statement is only a short one, and will be found on p. 72. There is hope that the Council will be in the position to make a further announcement on the subject at an early date.

A Question of Advertising.

The Michigan Gas Association, who are admitted by those best acquainted with the nature of their activities to be doing extremely important work, have had an experience which is less uncommon than one could wish in connection with organizations of a technical character. That is to say, their financial condition, in relation to their programme of work, has been such as to render imperative the raising of additional funds. Casting about for a means of securing the needful money, the Executive Committee of the Association hit upon the idea of raising a part of what was required by including advertisements in their printed "Transactions." Before definitely deciding upon the adoption of this course, the Secretary and Treasurer of the Association wrote asking the opinion of the "American Gaslight Journal" to the proposal, and received a reply to the effect that such a course, could in no wise be objectionable to them in the competitive sense but, on the contrary, might even prove of advantage. Our contemporary further stated that, while they regarded the technical discussions and interchange of thoughts and experiences which constitute the bulk of the matter in the editorial pages of the technical journal as of inestimable value to the engineer in his work, they did not lose sight of the fact that "a knowledge of the available tools of his trade is just as important to the gas-man as a knowledge of the principles underlying such work." This was, however, not the tenor of all the replies received to the inquiry; for the Secretary subsequently announced that some of the different gas journals with whom the matter had been taken up were in favour of the proposal, while others were not. In these circumstances, the Association—as they did not feel they could lose the goodwill and co-operation of any of these periodicals, and as they thought also it might be considered a "hold up" by the manufacturers—decided to abandon the scheme entirely for the time being. In this way, then, have the Michigan Gas Association answered the question which is asked by our contemporary in making the decision public—"Should the Gas Associations publish advertising in their 'Annual Proceedings'?"

A Proposed Sulphuric Acid Makers' Association.

There is occasion for the gas industry to keep widely opened eyes on a proposal, emanating from the Managing-Director of a well-known firm of sulphuric acid makers, that a National Association of Sulphuric Acid Manufacturers should be formed, with local sections. The proposal is outlined in a circular-letter recently forwarded to about fifty of the principal makers in England and Wales, and in which are included what the author of the scheme conceives to be some very sound reasons why such an Association should be established. We will first of all deal with the reason that particularly affects the gas industry. It recalls the old feud between the chemical manufacturers and the gas industry, whereby the former sought to have put on the latter certain statutory restrictions for the double purpose of preventing the development of the statutory gas industry *viâ* its residual products, and of promoting the interests of the non-statutory chemical manufacturers. It happens that one of the prominent leaders in the parliamentary warfare was a sulphuric acid maker. It has been suggested more than once since then that the gas industry, being a prolific producer of sulphur, might, to a much larger extent than now, become its own maker of sulphuric acid, either through the large gas undertakings, or through jointly capitalized private enterprises, free from legislative restrictions other than those in the general statutes affecting all chemical makers. We have in the letter an echo of the campaign. Where industries are organized as the writer proposes, he "can conceive even a British Government consenting to legislation whereby the entirely wasteful introduction of capital by superfluous and speculative parties, without experience in the trade, would be prohibited until the merits of the proposition had been examined by a Committee of expert manufacturers in conjunction with expert Government representatives." That is a very nice arrangement, and shows creditable imagination and ingenuity. Further, the author of the circular says: "This country will be placed for many years after peace is declared at such a disadvantage compared with neutrals—such as America—through the loss of lives and treasure in the war, that I believe it will be found in the national interest to prevent men inexperienced in any trade [we have in the gas industry men experienced in sulphuric acid production] from exploiting their own or public money in competition with existing interests. It must either mean a waste of that capital, or a reduction in the capital value of existing interests." Not necessarily the former.

Consumers and Makers' Organization.

And the capital value of existing interests is sometimes appreciated by organization and combination which are not always exercised with a benevolent eye on the consumers' interests. For instance, the author of the scheme proposes district associations "similar to that now existing in the Midland district, in which all interested in the sulphuric acid trade—dealers as well as makers—are pledged to co-operation." What are the lines that co-operation takes when makers and dealers are so pledged? Is the co-operation in favour of consumers, or of the makers and dealers? We get some indication in what succeeds. "In South Wales," we read, "there has been in existence for very many years past an excellent association. But there are one or two important makers in the district who are not members, and these abstentions from membership must of necessity greatly impair the usefulness of any association." In what way? In the matter of prices? If the interests of consumers are going to be jeopardized by the elimination of real and active competition, or by collusion in the matter of prices, then the proposed organization will not be in the national interests; and no business Government, unless dominated by the chemical manufacturers, would say that such combination and collusion deserve legislative protection by the denial to individuals in their private capacity of the right to utilize their private funds in any legitimate general trading enterprise. Coming to the other reasons advanced in favour of combination, the production of sulphuric acid has been greatly augmented during the war, mainly for explosives purposes. The gas industry has

assisted in this augmentation. The proposer of the new Association fears that absolute chaos must, consequent on this enlargement of supply, inevitably arise in the sulphuric acid trade on the conclusion of peace if makers are not closely associated. The "Chemical Trades Journal," on the other hand, inclines to the opinion that the industrial and agricultural developments that are taking place will enhance consumption in such a way as to absorb the bulk of the available supply. The drift of the author of the National Association scheme is plain. He fears that without combination the law of supply and demand will operate detrimentally to the makers. Objection cannot be urged against the other reasons advanced in favour of an Association—such as the securing of low freights upon imported material, reduced railway rates, and the purchasing of imported pyrites and other sulphur material through one large organization instead of the acid makers bidding against one another. The proposed organization is altogether an excellent idea—from the existing makers' standpoint.

PERSONAL.

Lt. and Qr.-Master R. D. MATTHEWS, of the R.A.M.C. (T.F.), who has been mentioned in Sir Douglas Haig's despatches for the second time, was for many years prior to enlistment an official in the Leeds Corporation Gas Department.

We learn that Mr. FRED JOURNET, representing the London house of Messrs. John Russell and Co., tube manufacturers, has just completed his fifty years' continuous service with the firm, and for the past forty years has devoted his time travelling partly in the Midlands, but chiefly in the South-West of England, over which territory he has made many friends in the gas profession.

Mr. T. H. HAZELL, the Secretary of the Newport (Mon.) Gas Company, has been unanimously nominated for the presidency of the local Chamber of Commerce, in which position he may be relied upon for good work. For a dozen years past he has been one of the most active and enthusiastic members, for more than half of which time he has served on the Council. At the beginning of 1913, he became Treasurer, continuing to hold this position until last year, when he was made a Vice-President.

It will be seen from the account of a presentation which appears in the news columns of this issue that Mr. HAMILTON BAKER has relinquished his appointment as Assistant Engineer to the Reading Gas Company, in order to go into partnership with his brother, of the firm of Messrs. Baker Bros., gas coal contractors, Reading. Mr. L. A. RUMBLE, for some years Draughtsman and Chemist, has been appointed to the vacant position. Mr. Baker, who has been with the Company for nearly thirty years, and of whose work and assistance Mr. Douglas H. Helps (the Engineer and Manager) speaks in the highest terms, is the son of Mr. Edward Baker, who was very well known in the industry, and brother of Mr. Herbert Baker—Mr. Helps's predecessor at Reading.

Mr. W. B. LEECH, the Manager of the Leeds Corporation Gas-Works, is to assist the Government in an important advisory capacity in connection with the war. Mr. Leech succeeded the late Mr. R. H. Townsley, the Engineer and Manager of the Leeds Gas-Works, three years ago. Born in Anglesey, he was educated at Wallasey, Liverpool, and was apprenticed to the engineering profession at Nuneaton. After this, he joined Mr. Maurice Graham, who was then with the New Conveyor Company, of Smethwick. When the firm of Messrs. Graham, Morton, & Co. was founded, he followed Mr. Graham to Leeds, and took charge of the erection of several large contracts for the firm—at the Granton Gas-Works, Milan, Nanterre, &c. In 1906, he accepted an appointment with the Edinburgh and Leith Corporations Gas Commissioners as Constructional Engineer, under Mr. W. R. Herring, and carried out large extensions at the works. On the completion of the agreement with them, he took over the firm of Messrs. Graham, Morton, & Co., which subsequently became known as Messrs. Leech, Goodall, & Co. He was a Director of the Vertical Gas-Retort Syndicate, of Westminster, and was thus responsible to some extent for the development of the intermittent vertical retort system in this country.

National Insurance (Unemployment) Act, 1916.—The Umpire has decided that contributions in respect of unemployment insurance are payable under the National Insurance (Part II.) (Munition Workers) Act, 1916, in respect of workmen engaged wholly or mainly in making metal reflectors for lighting purposes.

Calorific Standard Applications.—The Birkenhead Town Council have applied to the Local Government Board for an Order fixing a calorific power standard for their gas of 500 B.Th.U. The Secretary for Scotland has received an application for an Order from the Town Council of Arbroath. Applications for Orders, with a standard of 500 B.Th.U., have been forwarded to the Board of Trade by the Crowborough District Gas Company and the Newport (Mon.) Gas Company. The St. Albans Gas (Standard of Calorific Power) Order, 1917, has now been made by the Board of Trade.

DE-BADGING MEN EMPLOYED IN THE GAS INDUSTRY.

Negotiatiations by the National Gas Council.—A Reassuring Statement.

IN connection with the issue of circular "MM. 100" calling-in the badges from all semi-skilled and unskilled men employed in the gas industry, representatives of the National Gas Council have had a meeting with representatives of the Ministry of Munitions, and are in a position to state that the withdrawal of badges does not imply that the de-badged men are about to be, or will necessarily be, called up for military service. The step has been taken as a preliminary to a consideration of the extent to which such of the men as are physically fit for the fighting-line can be replaced by substitutes who are capable of taking their places after a brief period of training or without training. A definite understanding has, it is intimated, been arrived at between the Ministry of Munitions and the War Office under which no man will be taken for the Army from works engaged in washing gas with oil until a satisfactory substitute is provided. Should, therefore, any attempt be made by the recruiting authorities to compel, or persuade, indispensable de-badged men to enlist, the gas manager should immediately communicate with the Secretary of the Ministry of Munitions of War, No. 6, Whitehall Gardens and quote "M.W.146967/22."

Prompt steps are being taken to compile an agreed list of employees of gas undertakings graded as skilled, semi-skilled, or unskilled, together with particulars as to the type of man required as a substitute in cases where physique is a prime consideration. It is hoped to make a further intimation on the whole subject at an early date.

Meanwhile, managers may rest assured that the Ministry has no intention of allowing undertakings to be deprived of the minimum of labour essential to the carrying on of its work. But they must be prepared to co-operate readily with the authorities in the work of substitution wherever it can be carried out on practical lines, and must satisfy them that they themselves have done everything practicable in the direction of "combing out."

As a preliminary, it is essential that all men of military age should be medically examined and classified by the military authorities, if this has not already been done. In cases where essential men are holders of certificates of exemption instead of badges, and certificates are called-in for revision, full particulars should be forwarded at once to the Secretary of the Ministry of Munitions (to the address and with the reference number before stated), so that the matter may come within their purview.

ELECTRICITY SUPPLY MEMORANDA.

TAKING the country through, the electricity supply industry is a big offender in the matter of fuel waste—a waste that can be ill-afforded in these days. Take a generating station that is doing remarkably well (as things go) by consuming per kilowatt-hour generated 3 lbs. of coal of 15,000 B.Th.U. per lb. This is an expenditure of 45,000 B.Th.U. so as to realize 3420 B.Th.U.—a proportion of which is again wasted in being distributed and converted into light, heat, or power. And there are plants about the country that are using twice or three times this amount of coal per kilowatt-hour—some even more. It is a good thing, in present circumstances, that business extension on these fuel-wasting terms is being automatically limited by the conditions that exist, and that the administrators of the undertakings are accepting sterility in respect of new connections as the inevitable condition. The St. Pancras Borough Council have decided that, in view of the difficulty of obtaining cables and wires, no more private lighting connections are to be made during the war; and, further, until the new plant at the King's Road generating station is in operation, only certain applications for power can be entertained. There are other causes of enforced business curtailment. The greatest difficulty is being experienced in procuring spare parts of machinery, as makers are not allowed to put in hand spare parts without a special permit from the Government. The same kind of thing exists in connection with the gas industry. The St. Pancras electricity department has such a permit; but no materials obtained under it are to be used for any new plant, or for providing electric power to new customers, or extending supplies to old ones. With dear capital and expensive plant, and the necessity for fuel economy, it is as well that there are these restrictions. But as if to finally and effectually seal the means of securing any form of plant or other requisites in which copper is used, an order was issued last week by the Minister of Munitions commandeering unwrought copper (including copper scrap and swarf) in any form; certain exceptions being made in the case of existing contracts or of copper specially excepted by the Minister. Otherwise the selling, removing, or secreting of the metal, or dealing with it in any way not consented to by the Minister, will be an offence against the Defence of the Realm Act.

Restrictions at Home.

Restrictions in France.

These restrictions are indirect so far as consumption is concerned. In France, a more direct course of action has been taken by the Government to secure a fresh reduction in the consumption of electrical energy. The "Electrical Review" calls attention to this. The closing of shops at 6 p.m. (British shopkeepers have something for which to be thankful) throughout France, except pharmacies and shops dealing in food products, was found insufficient. At the end of November, a decree practically vested in the State the control of the electricity supplying works. Contracts for new supplies, as well as for an increase in existing supplies of electrical energy, were prohibited (without the sanction of the Minister of War) on all networks serving government establishments and munition factories. Where plant is deficient for local demand, including establishments engaged on work for national defence, the Minister of War has authority to issue an order of priority in respect of supply. It is further reported that a Council of Ministers has determined upon sweeping changes in private and public lighting; but it is left to those concerned to determine how these are to be carried out. All municipalities must effect a two-thirds reduction upon the normal consumption of the winter of 1913-14. As to private consumption, each individual is to be allowed normal consumption, providing it does not exceed 1 cubic metre (35¼ c.ft.) of gas, and three hectowatt-hours (300 watt-hours) of electricity. Beyond this minimum, the consumption is restricted according to a progressive table. The cost of the 35¼ c.ft. of gas and the 300 watt-hours of electricity would probably be about the same; but on the B.Th.U. basis the gas, at (adopting the British standard figure) 500 B.Th.U. per c.ft., would represent 17,625 B.Th.U.; the 300 watt-hours of electricity 1026 B.Th.U.

Electrical Contempt for Nitro-Energy.

We sympathize deeply with the American Mining Engineer who came to this country with a "Nitro-Energy" scheme in his hand for acceptance by the British nation It was to give electricity at one-fiftieth present cost, and in other respects was to revolutionize the ways of the world. It was bad enough that the kindly disposed American inventor should have a little sarcasm thrown at him from the columns of a gas paper, but that the electrical papers should say uncomplimentary things of his proposals, with a sneer of their nasal organs and a curl of their lips, is enough to make the Mining Engineer pack up his traps and hie him back to America, without divulging to anyone more details as to his portentous secret. The electrical papers are no doubt fully justified in all they have said, including the contempt which they have poured on the "Observer" for publishing such a mass of nonsense, which appears to be the production of a disordered mind, or of someone who wanted to play a practical joke upon our Sunday contemporary, which paper took up the matter quite seriously. But if the electrical papers had not been in such a hurry to kick and jump upon the scheme, they might have secured more particulars to supplement the fairy tale. The mischief. however, is done; and the American Mining Engineer must be very disappointed that his miraculous piece of work has had so tame though satirical a reception. The "Electrical Review" speaks of the article as fatuous drivel from first to last; and it regrets that the "Observer" should have dangled "nitro-energy" before an "anxious and unscientific" public. We cannot see the need or reason for the combination of "anxious" and "unscientific." Whether the anxiety is due to the want of science is not clear. However, our highly respectable and staid contemporary says that many times before it has had to remonstrate with its non-technical contemporaries over articles in connection with new inventions upon which they should have had expert opinion. "Meteor" of the "Electrical Times" opines that, after the article in question, the ordinary text-books on chemistry and the laws of Nature are now obsolete. All this is enough to make the American Mining Engineer slip into Germany *viâ* Holland or Switzerland, and offer his project to the Kaiser and his satellites. We beg of him, if he has any such intention, to defer doing so until Great Britain and her Allies have won the war without the aid of his project, because we do not want extra trouble to come before realizing complete victory. At the same time, the American Mining Engineer has not been shown that we deserve any consideration at his hands.

Interlinking Economies.

In a lecture which Mr. J. A. Robertson, the Borough Electrical Engineer of Salford, has lately delivered to the Technical Section of the Westinghouse Club, it appears he has three main views in regard to linking-up. The first is that the scheme is good to effect economy; the second is that, notwithstanding, it will never be carried out unless there is outside assistance on the part of the Government; the third is that linking-up means (taking the Lancashire and Cheshire scheme as an example) that probably ten years hence the whole of the area now supplied by twenty-one generating stations will be supplied by four or five, favourably situated in regard to coal supplies and condensing facilities. While linking-up does not form a complete solution of the electricity supply problem, it offers an immediate solution of the more pressing problems, at a minimum of cost. The principal advantages are: By pooling all the plant in the various stations, the necessity for each station keeping spare plant of its own would be obviated. "Linking-up" provides within certain limits a valuable safeguard against interruption of supply. A considerable saving in fuel would be effected. A certain number of stations could be shut-down at week-ends and on holidays. As to the technical difficulties, Mr. Robertson says these can be surmounted. Dealing with the Lancashire and Cheshire scheme, the Board of Trade, he thought, should set up a district joint board or committee for the whole area, which would include representatives of the several organizations concerned in the scheme. Of course, it would be possible for a single municipal supply authority, whose area was situated adjacent to several others, to wreck the whole scheme if it refused to allow interconnecting mains to pass through its area. Such a refusal could be indirectly countered, however. The Local Government Board, being the sanctioning authority for all money spent by local councils, could refuse to sanction loans to the particular authority refusing to enter into the scheme, and in this manner practically force it to co-operate with the other in authorities in the district. The principal advantage of the scheme, in Mr. Robertson's opinion, is that it would provide an easy road to centralization. One by one the inefficient stations would cease to generate electricity, and would act instead as transforming and distributing centres—the authorities selling energy in their districts at a price which could never have been realized if they had continued to operate their own plants. While the gas industry is seeking greater economy and efficiency by internal developments, it must not neglect to keep an eye on what its commercial opponents are doing.

Zeppelins and a Short-Circuit.

Short-circuits have their advantages as well as their disadvantages. We once heard of a burglar who was seriously inconvenienced by one; and now there is a very strong probability that we are indebted to a "short" for the destruction of two Zeppelins. The message comes from Copenhagen; the source of information is the "Ribe Stiftstidende." It is to the effect that on Dec. 28 a fire broke out in a double Zeppelin shed at Tondern (Schleswig-Holstein). "The outbreak was probably caused by a short-circuit. Both the Zeppelins in the shed were destroyed." Thank goodness, whatever the cause; if a short, double thanks.

Electrocutions, Fires, and Failures.

Last week a general survey was made of the affairs of the electrical industry during 1916 so far as the gas industry is specially interested; but the usual reference to the matters mentioned in this side-heading was omitted. With painful frequency during the year, the life-taking propensity of electricity was demonstrated, especially among workers in factories. The fatalities make in the aggregate a large showing; and not a few of them were due to shocks caused by low voltages—voltages such as are quite common in households. Breakdowns of electricity supply have in the total been numerous; and there have been many in certain places where the industrial demand, through the pressure of munition work, has told on generating plant working up to its full load. In January, the year started badly with collapses at Shrewsbury, Leeds, Aberystwith, Wallasey, and Wigan—the last-named place must, indeed, have got quite accustomed to such happenings during the year. In February, there was mention at a meeting of the Bristol Corporation of "occasional cessations." March heard of breakdowns at Dublin and Winchester; "considerable trouble" was reported in April from Accrington, which trouble seriously affected the mills relying on electrical energy. On April 4 we reported that "another recent ugly event is a fire (which caused some £2000 of damage) in the electric generating building of the Victoria Infirmary, Glasgow." An infirmary, it was remarked, is not a nice place for a fire. Hendon and Golders Green also had an experience of a failure, owing to a fault on one of the main cables of the North Metropolitan Electric Supply Company. Birmingham, through overworked plant, was badly hit during the year; Epsom was occasionally inconvenienced; and on Sunday, Nov. 19, the services in certain Lincoln churches were brought to a hurried close through the failure of the electric supply. In December, Carmarthen had a taste of an interruption. The newspapers are too much concerned with war news to take notice of such commonplace happenings as failures of electric current; and people are getting somewhat accustomed to them, and appear to take them now as a matter of course. But one point in the advocacy for the interlinking of systems is that it would contribute to the prevention of breakdowns of supply. The uncertainty of the "safety" of electricity has been further demonstrated in the course of the year. One Sunday evening the congregation at Lymington Parish Church were alarmed by seeing flames shooting out of the pulpit from which the Vicar was preaching. The electric wires had fused, and (being no respecters of persons) had set fire to the reverend gentleman's surplice. Fortunately the flames were put out before any serious injury was received by him. During a service at Holy Trinity Church, Woolwich, a fire broke out owing to the fusing of electric wires; and a similar occurrence was experienced on the premises of the Dunfermline Co-Operative Society. On Dec. 1 a fire broke out at the Princess's Theatre, Crayford; and the only cause to which it could be attributed was a fused electric wire. Towards the end of the year, Sir Stuart M. Samuel, M.P., had at his London residence a lesson regarding the fire-raising ability of a defective

electrical circuit. How well happenings of the kind are hushed up is demonstrated by the last annual report of Dr. Waldo, the Coroner of the City of London. He reported that no less than 26 fires investigated by him were due to defective electrical arrangements. All these fires being due to electricity in the City of London in a single year, how many more than those recorded here must have been experienced in the rest of the country? Data from America show the ratio of electrically caused fires is about 10 to 1, based on an equal number of meters in use. And while on this subject, we may quote the following from an article, by Professor H. E. Armstrong, upon which comment is made in our editorial columns this week: "Thus far gas has proved to be the safer system. From inquiry in a large London area, it appears that in 1915 only 44 fires were attributable to electricity and 59 to gas; but as there are 350,000 consumers of gas in the district, and only 15,000 of electric light, the fires attributable to electricity are more numerous than those due to gas in the proportion of 17·3 to 1."

MUNICIPAL GAS PROFITS AND INCOME-TAX.

By F. OGDEN WHITELEY, F.S.A.A., City Treasurer, Bradford.

IN response to your invitation, I have pleasure to contribute a few notes upon this subject arising out of the debate at the Stockport Town Council, referred to in your issues of Dec. 12 and 19, upon the proposal to appoint a Special Committee to review the basis on which contributions from trading profits in relief of rates have been made.

Two separate and distinct points appear to have been confused by several of the speakers in the course of the discussion. The first point is as to whether the charges for commodities produced, or services rendered, by the trading undertakings of local authorities shall be maintained at such a figure as to ensure that each year a surplus will be available for the relief of rates, or whether the charges shall be fixed with the object of providing the commodities or services at as nearly cost price as is possible.

Upon this point there have been very heated arguments ever since municipalities generally undertook the control of public services, such as gas, water, electricity, tramways, &c., which are in the nature of monopolies. On the one hand we have those who contend that there should be some benefit from the trading undertakings in the shape of reduced rate poundage, inasmuch as capital moneys necessary for the undertakings are borrowed at a comparatively low rate of interest, *because they are borrowed on the security of the whole of the rates, rents, and property of the authority concerned*, and consequently the ratepayers who contribute to that security carry obligation to meet deficiencies, or to pay the interest and liquidate the debt in case the continuance of the undertaking should, by reason of scientific development or otherwise, cease to be practicable. On the other hand, the question is raised: Why should the person who uses gas pay a higher charge than is absolutely necessary, in order that rates may be relieved, and thus financial benefit be afforded to many firms and persons who do not use gas? A discussion on this side of the problem would raise not only the broad question "Yea!" or "Nay!" but also a consideration of the extent of relief which may be justified.

The Stockport proposal, however, does not appear to arise out of, or be dependent upon, the principle of contribution of trading profits in relief of rates, *per se*, but rather the separate question of safeguarding the local authority from payment of a greater amount of imperial taxation than is just or necessary. I propose, therefore, to confine my observations to this aspect of the question, upon which there appears to have been some misunderstanding.

One or two of the speakers implied that the charge for income-tax would be reduced if the cost of providing new machinery and certain other things were met out of revenue. As a matter of fact, unless the new machinery were in the nature of a renewal, the cost would not be allowed as an expense in arriving at the assessable profits.

The proposer of the resolution, and also his supporters, have apparently no knowledge of, or have entirely overlooked, the settlement which has been arrived at, on behalf of local authorities, between the Inland Revenue Department and the Institute of Municipal Treasurers and Accountants arising out of the decision in the Leeds test case.

It is, of course, generally known that upon the payment of all interest on loans, the financial officers of local authorities are bound to deduct income-tax, and account for such tax to the Inland Revenue Department. Where, however, the assessable profits of any undertaking are greater than the amount of interest from which tax has been deducted, the assessment upon the profits covers the liability in respect of the interest. So that if the assessable profits under Schedules A and D of (say) a gas undertaking were £40,000, and the interest on loans in respect of the undertaking amounted to £30,000, the authority would be liable for payment of income-tax upon the former sum. But, having deducted and retained the tax when paying the interest, the net charge against the undertaking would be on £10,000—the burden of income-tax on the sum of £30,000 being borne by the mortgagees and stockholders.

With regard to the interest on loans in respect of the unproductive undertakings—such as parks, hospitals, sewage works, &c.—there are no taxable profits. Prior to the recent settlement above referred to, local authorities were bound to hand over to the Inland Revenue Department the tax deducted; and they were assessed thereto, after deducting from the assessment only the amount of profits *actually transferred from trading undertakings in relief of rates*.

The effect of the settlement is that, for the purpose of arriving at the income-tax liability of a local authority, the accounts of the whole of the undertakings comprised within each separate fund may be pooled; so that a loss upon one undertaking may be set off against profits of other undertakings secured upon the same fund. Further that, after meeting statutory obligations, any surplus profits of any undertaking in respect of which income-tax has been paid, are available as a "set-off" against the liability of the authority to pay over the tax deducted by them from the interest on loans of the non-trading undertakings within the same fund. It is immaterial whether such profits have been actually transferred or not, if it is legally permissible to make the transfer.

The present position is illustrated by the following figures, assuming that the undertakings mentioned are each secured upon the same fund—say, the district fund:

Undertaking.	Assessable Profits.	Deduct Charges against Profits. Interest on Loans.	Sinking Fund Contribution or Depreciation.	Total.	Amount available as "set-off" against Rating Fund Interest.
	£	£	£	£	£
Gas works . . .	40,000	18,000	12,000	30,000	10,000
Electricity works .	20,000	10,000	5,000	15,000	5,000
	60,000	28,000	17,000	45,000	15,000
The total interest on loans, upon the unproductive undertakings of the district fund, from which tax has been deducted by the local authority, amounts to					30,000
But the authority is allowed to credit the surplus profits from the trading undertakings, as above.					15,000
Leaving a net sum upon which the authority is required to pay over the tax to the Inland Revenue in respect of the interest on unproductive undertakings of					15,000

Now supposing that, in order to reduce the liability for income-tax upon the trading undertakings, the scales of charges are revised, with the result that the assessable profits amount to £50,000, instead of £60,000, as shown in the above example, income-tax upon £10,000 would be saved to the trading undertakings. But the surplus profits available as a "set-off" against the interest upon the unproductive undertakings would be less by £10,000. Consequently, the local authority would be liable to account to the Inland Revenue in respect of those undertakings for the tax on £25,000, instead of on £15,000—the position of the authority as a whole being unaltered.

It may be, of course, that the surplus profits from the trading undertakings are more than sufficient to cover the liability in respect of the interest upon the unproductive undertakings, in which case saving of income-tax might be effected by a revision of the scale of charges.

These are not the only points which will require the close attention of any local authority which proposes to make a revision in the charges in order to effect a reduction in their liability to imperial taxation. As is well known, the rating assessments of trading undertakings are based upon the profits, and a reduction of the assessments would follow any decrease in the profits. This would have the effect of restoring to some extent the taxable profits, while reducing the direct contribution to local rates. Certain charges against local authorities—such as contributions to joint boards, &c.—are in many cases based upon the rateable value or assessable value of the district; and reduction in such values would tend to decrease the contributions payable by an authority, unless, of course, each contributing authority made similar adjustments. On the other hand, many Government grants to local authorities and allocations of Exchequer contributions are based upon the valuation list.

It will be seen, therefore, that if it be a question of adjustment of scales of charges in order to safeguard the financial interests of the local authority as a whole in its relation to the Imperial Government and other outside authorities, careful consideration of the entire position is necessary, in order that the net result of any revision may not be a case of "saving on the swings and losing on the roundabouts."

Lieutenant WILLIAM COX, R.N.R., who has died on active service, was formerly employed in the Belfast gas office.

There will be heartfelt sympathy on all sides with Mr. H. TOWNSEND, the Managing-Director of the Wakefield Gas Company, in the overwhelming bereavements which the war has inflicted upon him. After having two of his sons killed, he has now to mourn the loss of his wife, who passed away last Wednesday. She never recovered from the shock caused by the death of her boys.

GAS LEGISLATION FOR 1917.

[SECOND ARTICLE.]

THERE only remain for review four Gas Bills and two Provisional Orders.

The KENILWORTH GAS COMPANY are seeking incorporation and extended and modern powers. From the preamble of the Bill, it is gathered that their share capital at present consists of £15,000, divided into 500 shares of £10 each entitled to a preferential dividend of 5 per cent. per annum, and 1000 ordinary shares of £10 each. The Company have also borrowed £1000 on debentures. With an increasing consumption within the area of supply, and places adjacent wholly without the benefits of a supply, the Company desire to enlarge their works, and to extend their mains and distribute gas within newly-defined limits. By their Act of 1865, the Leamington Priors Gas Company were authorized to supply gas within certain limits, which included the district within five miles in every direction from the works of that Company, excluding the borough of Warwick. Part of the district of Kenilworth and a small portion of the parish of Stoneleigh which are proposed to be included within the limits of supply of the present promoters are within five miles of the works of the Leamington Company. But this Company are not supplying, and have never supplied, gas in the urban district or parish; and it is therefore submitted that it is expedient the districts in question should be excluded from the Leamington Company's boundaries. Passing over the reincorporating clauses, and the consequential provisions, it is proposed that the capital shall now be £55,000, which aggregate is constituted of the following sums: Capital stock to the amount of £20,000, being stock created in respect of the existing ordinary capital of £10,000, and to be called "A" ordinary stock; capital stock to the amount of £5000, being stock created in respect of the existing preference capital of £5000, which shall be called "B" preference stock; and £30,000 additional capital. The £20,000 of "A" ordinary stock, it is proposed to divide among the holders of the ordinary shares in the limited Company in the proportion of £20 of such stock for each ordinary share held by them; and the £5000 of preference stock is to be divided among the holders of the present preference shares in proportion to the amount held by them respectively. The Company are making provision to create and issue all or any of the preference shares or stock or debenture stock authorized to be created and issued under the Act, so as to be redeemable on such terms and conditions as may be specified in a resolution passed at a special meeting convened for the purpose. The conditions may be those determined upon by the Private Bill Authorities last session, as mentioned last week in the notice of the Haslemere Act. Regarding dividends. On the "A" ordinary and the "B" preference stock 5 p.ct. is specified, on the additional ordinary capital 7 p.ct., on the additional preference capital 6 p.ct. Power to declare an interim dividend without the sanction of a general meeting is asked for. Borrowing powers are sought up to one-third of the capital issued and paid-up (including premiums); the one-third embracing the £1000 already borrowed. Annual meetings in May or June are arranged for. The name of Mr. Thomas Berridge is among the first Directors. Later provision is made for the appointment of a Managing Director. Attached to the works' clause are the residuals provisions, *minus* the objectionable one-third purchasing restriction. The Warwickshire County Council and the London and North-Western Railway Company have protecting clauses. The limits of supply are defined; and a clause provides for the cancellation of the supply powers of the Leamington Company already referred to. As to the price of gas, not exceeding 4s. 9d. is proposed within a radius of 2 miles from the scheduled gas-works land, and beyond the radius the price is not to exceed by more than 1s. the price for the time being charged within the radius. Power to charge differential prices according to the purpose for which the gas is consumed is asked for. A stand-by clause is included; and then comes the calorific power provisions instituting a standard of 500 B.Th.U. tested by the apparatus and under the conditions prescribed by the Metropolitan Gas Referees. A minimum pressure of 1 in. is proposed. There are clauses as to the issue of stock under the co-partnership rules, as to nominations in regard to the transfer of stock held by employees, and as to the establishing of a benefit fund. [*Parliamentary Agents: Messrs. Lees & Co.*]

The LEA BRIDGE DISTRICT GAS COMPANY are getting towards the end of their tether in regard to capital powers. There only remains to be issued £8710 of capital stock and £17,624 of loan capital. The total of the consolidated ordinary 5 p.ct. stock paid up is £235,242, in addition to which premiums amounting to £18,725 have been received. The amount of 5 p.ct. preference stock paid up is £15,000, with premiums amounting to £2565. The total of the perpetual debenture stock borrowed is £44,876. The Company desire to extend their works; and appended to the works' clause are residuals powers with the one-third restriction very properly excluded. The additional capital powers sought amount to £200,000; and a succeeding clause is intended to remove the limit on the dividend on preference stock:

> The provisions of section 31 of the Act of 1899, in so far as they limit the rate of dividend on the preference stock of the Company, are hereby repealed; and any preference stock which may be hereafter created under the powers of that Act, or which may be created under the powers of this Act, may be stock with a dividend at such rate as the Directors of the Company may determine at the time or times of the creation thereof.

Borrowing powers on the usual one-third basis are proposed both in respect of the additional capital and the existing authorized capital. The Company also desire that the provisions of the Statutory Companies (Redeemable Stock) Act, 1915, shall extend and apply to the Company as if any preference or debenture stock which the Company is authorized to raise under the powers of this Act were such preference or debenture stock as is referred to in section 1 of the 1915 Act. Reserve, special purposes, and war benefit funds and pension allowances are provided for. A number of modern and now usual clauses are included in the Bill; among them being one for the purchase of gas in a crude or partially purified state. A differential prices clause also appears. The Company are also asking that:

> The number of Directors of the Company provided for by section 51 of the Act of 1878 may from time to time be deemed to be increased by one, for the purpose of any person retiring from the office of chief engineer, general manager, or secretary of the Company being appointed and acting as a Director of the Company; and so long as any such person is a Director of the Company, the fees payable to the Directors shall be increased in proportion to the increase in the number of the Directors. Provided always that in no event shall there be more than one such person at the same time holding office as Director by virtue of the provisions of this section.

The remaining clauses do not call for notice. [*Parliamentary Agents: Messrs. Sherwood & Co.*]

The SHEFFIELD UNITED GAS LIGHT COMPANY are in Parliament seeking authorization to the raising of additional capital, the changing of the name of the Company, and for other purposes. As to the present position of the share and loan capital, the whole of that authorized by the Acts of 1855 and 1866 has been issued, fully paid up, and converted into capital stock, and the share capital now consists of the following: £136,000 "A" stock, representing the "A" and "B" shares authorized by the Act of 1855; £209,984 "B" stock, representing the "C," "D," and "E" shares and the loan capital also authorized by the Act of 1855; and £523,000 "C" stock, representing the share and loan capital authorized by the Act of 1866. By the Company's Order of 1893, they were authorized to issue debenture stock up to £200,000, but subject to a maximum rate of interest of 4 p.ct. per annum In the exercise of the powers so conferred on them, the Company have issued debenture stock to the amount of £95,000; but they are unable to issue any further part of such stock, owing to the limit on the rate of interest. The Company have received by way of premiums on the issue of the additional capital authorized by the Act of 1866, and of the debenture stock authorized by the Order of 1893, sums of upwards of £9200 and £13,800 respectively. They have expended on purposes to which capital is properly applicable the whole of the moneys (including premiums) received by them by the issue of share capital and debenture stock, and in addition £70,000 and upwards. It is submitted that the demand for gas within the limits of supply has increased considerably—more especially since the commencement of the war, and will continue to increase; and it is therefore expedient and urgent that the Company should be authorized to raise additional capital, and that the limit on the interest payable on any debenture stock be repealed. The dividends payable on the Company's "A," "B," and "C" stocks are limited to 10 p.ct. per annum, subject to reductions in the case of the "B" and "C" stocks if the Company's general charge for gas shall exceed 3s. 6d. and 2s. 9d. respectively; and it is considered expedient that the stocks should be converted into stocks of the amounts, and entitled to the rates of dividend, provided by the present measure. Additional gas-works powers, and an extension of the limits of supply, are sought. Leaving the preamble of the Bill, it is seen from the clauses that the Company desire to eliminate "United" and "Light" from their title—thus shortening the name to the "Sheffield Gas Company." The existing "A," "B," and "C" stocks are to be converted into new ordinary stocks, known as new "A" stock, new "B" stock, and new "C" stock, which are to be vested in the holders of the existing "A," "B," and "C" stocks as follows: For every £1 of "A" stock, £2 of new "A" stock; for every £1 of "B" stock £2 of new "B" stock; and for every £1 of "C" stock £2 of new "C" stock. The additional capital powers sought for amount of £600,000. As to borrowing authorization, the Company contemplate, at any time after the date of the conversion, the borrowing on mortgage, in respect of the £1,736,968 of new stock into which the share capital authorized by the existing Acts is converted, and of the premiums of £9000 upwards received on the issue of such capital, any sum or sums not exceeding in the whole £580,000, inclusive of any sums raised or to be raised by them by the issue of debenture stock under the provisions of the Order of 1893 as amended by the present measure. The Company also seek to borrow in respect of the additional capital up to one-third part. They further desire power to raise as redeemable preference shares or stock any capital which they are now asking authority to raise, or any debenture stock under the powers of this Act or of the amended

Order of 1893, on the terms laid down last session. A sinking fund clause is included in the following terms:

(1) The Directors may, if they think fit, in respect of any year appropriate out of the revenue of the Company, as part of the expenditure on revenue account, any sum not exceeding the amount which would be produced by 1d. per 1000 c.ft. of the gas supplied by the Company during such year to a fund to be called the "sinking fund": Provided that the total amount so appropriated to the sinking fund shall not at any time be greater than the amount of the additional capital (including loan capital) which shall have been issued under the powers of this Act.

(2) Any sums so transferred to the sinking fund shall from time to time be applied to any purposes to which capital is properly applicable, and pending such application may be invested as the Directors determine in securities in which trustees are by law authorized to invest, or placed on deposit with the Company's bankers.

(3) The dividends and interest arising from the sinking fund shall form part of the revenue of the Company, and may be applied to any purposes to which revenue is properly applicable.

The dividends proposed are: On the preference shares or stock (if any), such rate per annum as is specified in the resolution creating the stock; on the new "A" stock, 5 p.ct. per annum; on the new "B" stock, 4 p.ct. per annum, so long as the general charge for gas per 1000 c.ft. shall exceed 3s. 6d. per 1000 c.ft., and 5 p.ct. per annum so long as the general charge shall not exceed 3s. 6d.; on the new "C" stock and on all ordinary shares or stock to be issued as additional capital under the Act, at the rate of 3½ p.ct. per annum so long as the general charge for gas exceeds 3s. 3d., at the rate of 3¾ p.ct. per annum so long as the general charge exceeds 3s., but does not exceed 3s. 3d., at the rate of 4½ p.ct. per annum so long as the general charge exceeds 2s. 9d., but does not exceed 3s., and at the rate of 5 p.ct. per annum so long as the general charge does not exceed 2s. 9d. It is explained that the "general charge" for gas means the charge to consumers within the limits defined by the Act of 1855, and not having a special contract. It is proposed to extend the limits of supply, so as to include Tankersley, in which district mains and pipes have been already laid by the Company. Lands are described upon which the Company desire to construct works. Appended to the works clause are the residual products powers, with the one-third purchasing restriction. The next series of clauses, under the heading of "Non-Standard Gas," are particularly interesting. They are to empower the Company to purchase coke-oven gas, and to lay special mains and pipes for the purpose of supply. It is also provided that none of the existing provisions as to calorific power, purity, pressure, testing, or price of gas shall apply to any gas supplied under the provisions of this section. Similar provision also specially excludes from those obligations gas supplied for utilization for power purposes; while the Company ask for the right to charge in respect of power gas supplied to the occupier of any premises within the limits of supply such sums as may be agreed between them and the occupier. Other provisions usually applied to the supply of power gas appear. The remaining clauses are of ordinary character. [*Parliamentary Agents: Messrs. Rees & Freres.*]

The SOUTH STAFFORDSHIRE MOND GAS (POWER AND HEATING) COMPANY are in Parliament asking for certain additional financial and price powers. From the preamble we gather that the amount of share capital authorized is £500,000 of ordinary and £500,000 of cumulative preference. Of the former, the sum of £340,712 has been raised, and of the latter £82,500. Of 5 p.ct. debenture stock £333,333 has been authorized, and £128,330 issued; while the actual amount raised is £107,830. The Company have paid all interest on the debenture stock; and on the ordinary shares 1 p.ct. in 1911, 2½ p.ct. in 1912, and 1¾ p.ct. in 1913. In 1914 and 1915, there were no payments on the ordinary shares; but in those years 6 p.ct. was paid on the preference shares. The demand for gas for power and heating purposes is increasing; and, the promoters submit, there is immediate need for an extension of the works for the purpose of meeting urgent national requirements. By reason of the financial position resulting from the war, the Company are unable to raise money by the unissued share capital, which, under the Acts relating thereto, may not be issued at a price below par. Regarding the charges for gas, by the Act of 1901, the Company were authorized to charge and receive in respect of gas supplied by them such sums as may be agreed between them and the consumer, being at a rate or price not exceeding 3d. per 1000 c.ft. if the quantity taken be not less than 4 million c.ft. per quarter, and not exceeding 4d. per 1000 c.ft. if the quantity taken be less than the above. But if at any time it is proved to the satisfaction of the Board of Trade that the price of good quality slack exceeds 6s. per ton delivered at the Company's works, then the Board of Trade may by Order authorize an increase in the price of gas (beyond the above maximum) by ⅛d. per 1000 c.ft. for every 1s. by which the price of slack per ton shall exceed 6s. per ton when delivered at the works of the Company, or by such other proportionate amount as the Board of Trade may determine, and for such period in either case as the Board of Trade may fix, with power to the Board to extend any such period so long as such excess of price continues. Doubts have been raised whether under these provisions the Board of Trade in considering the question of increasing the price of gas may regard any matter other than the gross cost of fuel. But since the passing of the Act of 1901, owing to circumstances over which the Company have no control, the cost of production of gas by them has largely increased, not only as regards the price of fuel, but in various other respects; and the cost is likely to increase still further. The average price per 1000 c.ft. now obtained for the gas is almost identical with the present cost of its production (after allowing for the sale of residual products), and for interest on the debenture stock; but it does not allow for any sum by way of dividend on the preference or ordinary capital. The Directors of the Company therefore by the clauses ask for authority to create and raise, on such terms as they may think fit, either at their option by borrowing on mortgage of the undertaking or by the creation and issue of debenture stock, or partly by either of such means, the sum of £205,000, irrespective of the amount of the capital at the time actually raised by the issue of shares or stock, provided that "any moneys raised in exercise of the powers of this section shall for all purposes, including the purposes of the Statutory Companies (Redeemable Stock) Act, 1915, be deemed to have been created or issued and raised under the Act of 1901." The next clause proposes to repeal section 49 (Charges for Supply) of the Act of 1901, and in lieu thereof to apply the following provisions:

> Notwithstanding anything contained in any existing agreement, the Company may charge and receive in respect of gas supplied by them such sums as may be agreed between them and the consumer, being at a rate or price not exceeding 5½d. per 1000 c.ft., if the quantity taken by the consumer for use at any one house, building, or factory be not less than 4 million c.ft. per quarter of thirteen weeks, and not exceeding 6½d. per 1000 c.ft. if the quantity so taken by the consumer be less than the above: Provided that if at any time it be proved to the satisfaction of the Board of Trade that the cost of production of gas by the Company is in excess of the cost of such production in the month of January, 1917, then the said Board may by Order increase the said maximum prices, and may from time to time vary any such Order, and the said Board may for such purposes institute at the expense of the Company such inquiries as they may think fit. Provided always that every person entitled to demand a supply of gas from the Company shall be entitled to such supply on the same terms as any other person who is receiving a corresponding supply for a similar purpose in like circumstances; and the Company shall not in making any agreement for affording a supply of gas show any undue preference to any person.

The repeal is also sought of section 50 (Revision of Prices, &c.) of the Act of 1901; and, in lieu thereof, it is proposed that the following provision shall apply:

> The Board of Trade may, at any time after the month of January, 1922, on the application of the Company or of any local authority within the district, or of not less than twenty consumers of gas supplied by the Company, revise the maximum prices contained in this Act, and may on the like application make a similar revision at the expiration of a period of five years from the date at which the last such revision has taken place.

The only other clause refers to the costs of the Act. [*Parliamentary Agents: Messrs. Sherwood & Co.*]

PROVISIONAL ORDERS.

The Provisional Order promoted by the STRETFORD GAS COMPANY is only for a single purpose. It is to extend the powers of the Company for the manufacture and conversion of residual products arising in the manufacture of gas, and to amend the Act of 1899. The clauses referring to this matter state that, in addition to the lands which the undertakers are now authorized to use for the purposes mentioned, "they may upon the lands described in Part II. and Part III. of the first schedule to the Stretford Gas Act, 1899, and upon any lands upon which they are by any Act or Order authorized to make and store gas, or upon any part thereof, erect, maintain, alter, enlarge, renew, improve, and use such works, buildings, apparatus, and conveniences as they may think fit, and may make, work-up, convert, store, supply, and deal-in all products arising directly or indirectly from the manufacture of gas, and may do all such acts and things as they may consider necessary and proper for, or in connection with, the purposes aforesaid or any of them." The next section provides for the repeal of section 14 (Gas, &c., not to be Manufactured except on Lands Scheduled) of the Company's Act of 1899, and of the words "but not from the working-up, manufacture, or conversion of residual products" in section 13 (Construction and Maintenance of Gas-Works, &c.). [*Parliamentary Agents: Messrs. Sharpe, Pritchard, & Co.*]

The TONBRIDGE GAS COMPANY are the promoters of an Order which, in the first place, proposes to extend the limits of supply in a manner particularly described in two pages of printed matter. Next they desire confirmation of the purchase by them of additional land described in the schedule. The land in question contains some 6½ acres, and is bounded on the north-west by the River Medway, and on the west by other land belonging to the Company. The succeeding clauses empower the use of the land for manufacturing purposes. As to capital, the Company ask that in addition to the original and additional capital as defined and authorized by their Act of 1872 and by the Orders of 1890 and 1899, they may raise further sums not exceeding in the whole £50,000 by the creation and issue of new ordinary shares or stock or new preference shares or stock. Regarding borrow-

ing powers, the promoters desire that on the new capital the proportion shall be one-third, and that a further £5000 shall be allowed in addition to the existing authorization in respect of the capital granted by the Act of 1872 and the Orders of 1890 and 1899. The dividends proposed on the additional capital are 7 p.ct. on the ordinary and 6 p.ct. on the preference. The issue of redeemable debenture stock is sought; the manner of redemption being by paying-off the stock or providing substituted stock. The Company also ask for authority to set aside out of revenue, after providing for the payment of interest on any loan or on any guaranteed debenture stock, and other fixed charges and obligations, such sums as they may consider proper for the purpose of forming a fund for the redemption at maturity of any debenture stock which, under the conditions of issue, is to be redeemed wholly or partly in cash. The promoters suggest that they shall be limited (without they obtain the consent of the Board of Trade) to the payment of interest at not exceeding a higher rate than 7 p.ct. per annum, in respect of any money borrowed on mortgage or any debenture stock. A special purposes fund is provided for. Then follows the substitution of the calorific value standard for the illuminating power one. The figure proposed is 500 B.Th.U. Complying with the decision of the Board under the Calorific Power Act, 1916, authorization to make a quinquennial application for a revision of the standard is included; and then it is noticed that a minimum pressure of 12-10ths is proposed, in lieu of the ordinary 8-10ths. In the added limits of supply, the Company seek authority to charge not exceeding 9d. more per 1000 c.ft. than the price for the time being charged by them within the limits of supply as defined by the Act of 1872; but the price is in no case to exceed 4s. 6d. The ordinary provisions regarding the supply of power gas are sought. The remaining clauses, including a stand-by one, are of quite the ordinary form. [*Parliamentary Agents: Messrs. Smiles & Co.*]

DIGEST OF PATENT CASES.

THERE has been compiled by Mr. Frank G. Underhay, M.A., one of the Editors of the "Reports of Patent, &c., Cases," a digest of the contents of Vol. XXXIII., in which attention is drawn to various points which may perhaps arise again in connection with subsequent disputes.

Among the cases which are noticed in regard to patents, is a petition for extension, which was dismissed; one of the grounds for this decision being that the want of commercial success was due to failure to appreciate the value of the invention, and that this was not a ground for extension. In one action the infringement complained of was the sale of articles below a minimum price fixed by a limited licence; and in this the plaintiffs were successful. The defendants alleged a custom, which it was held had not been proved, to sell goods damaged—as these had been by fire on their premises—at any price. Then there was a case which went up to the House of Lords (the patent being declared invalid) in which, on one suggested construction, the specification was held to be misleading, because the invention did not accomplish the result claimed. There were here other questions for consideration; and Lord Parker, in his judgment, said: "A mere selection among possible alternatives is not subject-matter. A selection, to be patentable, must be a selection to secure some advantage or avoid some disadvantage; and, in describing such an invention, the advantages to be gained, or the disadvantages to be avoided, ought to be referred to." Another unfortunate patentee was held to have claimed more than he had invented; the patent being consequently declared invalid.

The volume, in fact, as Mr. Underhay concisely shows, contains many warnings to inventors. To what has already been said, it may be added that one claim in a specification was held on its true construction to be invalid, as in one alternative claimed the machine would not work; while another specification was said to be so vague and indefinite that it failed to describe any invention at all.

The digest is published as a supplement to the "Official Patents Journal;" and it deals, besides patents, with design and trade mark cases.

Expansion of Quicklime when Wetted.—A recent number of "Engineer" reproduced from an American publication some particulars as to the enormous force developed by wetting quicklime, which acts slowly and almost irresistibly—a force that has long invited use for mechanical purposes. Successful efforts are described to make use of it in breaking-up heavy masonry. A number of 12 ft. × 20 ft. piers, 12 ft. high, were situated between similar foundation piers for engines in operation; and it was necessary to remove them without injuring the machinery. Blasting was, therefore, inadmissible; and hand cutting and breaking was too slow and expensive. The work was accomplished by drilling 3 in. vertical holes 3 ft. deep and 3 ft. apart in both directions over the entire areas of the piers, and filling them within 6 in. of the top with fresh slacked lime in pieces ¾ in. to 1¾ in. wide. As soon as the lime was thoroughly wet, the tops of the holes were filled with brick-drilling well tamped; and in about ten minutes cracks started in every direction, and the entire top of the foundation pier was broken into 3 ft. cubes.

AMMONIA RECOVERY AND "INTENSIVE" SCRUBBING.

In a recent communication to "Gas Record" Mr. Warren S. Blauvelt states that a washer or scrubber as ordinarily used in gas-works absorbs ammonia from the impure gas by means of the water fed into the apparatus, and that the weak liquor thus produced takes up acid impurities to a certain extent. The conditions best suited to the primary function are equally favourable to the secondary; and an apparatus properly designed for ammonia recovery is equally efficient for the absorption of carbon dioxide and sulphuretted hydrogen. When a gas rich in ammonia is introduced to clean water, the absorbtion of the alkali is rapid; but as the gas loses and the water gains, the action gradually decreases, and a point may be reached when the passing of ammonia from the gas to the water may be equalled by that passing from the water to the gas. When continued contact of gas and water, under fixed pressure and temperature conditions, is attended with no change in the quantity taken up by the liquid, ammonia vapour equilibrium between the two is said to have been established. The maximum strength of liquor that can by any possibility be obtained with any ammonia recovery apparatus is therefore definitely limited to the vapour equilibrium is neither practicable nor profitable. The complete recovery of ammonia combined with a maximum strength of liquor is possible of attainment with quite simple apparatus, notwithstanding the needless complication in design, large size, and consequent excessive cost, of many devices employed for this purpose. These may be divided into four classes:

I.—The bubbling washer, so constructed that the gas is caused to bubble through the liquid.

II.—The tower scrubber, in which the gas ascends in contact with a descending stream of liquid, and which may consist of an open chamber, be fitted with baffles or trays, or packed with coke, tiles, boards, &c., to increase the contact area and the time required for the liquid to traverse the apparatus—a distinguishing feature being that the liquid passes but once.

III.—Mechanical washers, in which certain internal parts are kept in motion, with a view of securing an intimate contact between the passing gas and the liquid. These are generally "multi-stage;" the liquid passing from one compartment to the next, in a direction counter to the flow of gas.

IV.—The intensive scrubber, comprising a number of towers or compartments, each packed with wooden grids to ensure a large contact area. Circulating pumps are fitted to each tower, drawing from the base and delivering to the top; thus securing continual movement of the liquid. A small quantity of water is supplied to the last compartment, and passed forward from time to time; the working being in this respect similar to that of the mechanical washer. It is divided into sections consisting of one, two, or three compartments, and provided with bye-pass valves that enable any one compartment to be cut out of service, without interference with the operations of the remainder. With some of the compartments thus shut off, the complete extraction of ammonia can be maintained by increasing the supply of liquid; but the resulting liquor is weaker.

Provided there is sufficient contact between gas and liquid, it is possible to obtain approximate vapour equilibrium with any of these four general classes; and the time of contact, area of contact surface, form and size of the gas passages, determine the degree of efficiency obtained. The tower scrubber is cheap, without moving parts, and gives no appreciable back-pressure, and is therefore the more satisfactory type for small gas-works. But it is not suited to large installations; the size required, if efficient working results are to be secured, being prohibitive. The bubbling washer is used as an auxiliary to, rather than as a complete substitute for, the tower scrubber, because several stages, involving an aggregate high back-pressure, are required to ensure the best working conditions. For large works, either the mechanical washer or the intensive scrubber is the more suitable, and with properly designed and operated apparatus, combined with a sufficient number of stages, commercially complete recovery of ammonia, together with reasonably strong liquor, can be obtained. Complete vapour equilibrium and extraction of ammonia are impracticable, on account of the number of stages and size of apparatus necessary for the finishing operations; and in ordinary working it is seldom profitable to reduce the ammonia content of the exit gas below 2 grains per 100 c.ft., or to raise the strength of the effluent beyond 2½ p.ct. of ammonia. The possible strength is limited by the ammonia content of the incoming gas, the temperature of the liquid and gas, and the number of stages.

The choice of apparatus may therefore depend on commercial considerations; the best being that which will yield commercially satisfactory conditions at the lowest possible total cost—to include capital charges for plant, buildings, foundations, and ground area occupied, operating labour, and supervision. In the intensive scrubber, the entire contact surface is constantly exposed to the gas; but in the mechanical washer a large pro-

portion (approximately, one-third) is at all times submerged and doing no useful work. To secure the same extent of efficient contact area, the total provided, if the mechanical washer is used, must greatly exceed that in the intensive scrubber. Having no moving parts, the construction of the latter is obviously simpler, requires less space, costs less to instal, and needs no building other than a shed to cover the pumps.

During the first few years followed erection, the repairs are negligible in each case; but over a long term of years the advantage is decidedly with the intensive scrubber—being confined principally to renewal of the wearing parts of the pumps. The total power required is that thrown on the exhausters by back-pressure, together with that employed in pumping or otherwise moving the liquids concerned; and at normal load there is practically little difference between the two classes in this respect. But under overload, the intensive scrubber has the advantage. The same applies with exceptionally foul gas or impure water or naphthalene trouble, as the separate sections greatly facilitate cleaning and replacing grids, or steaming-out plugged sections, without interference with efficient operation. The intensive scrubber combines extreme simplicity with relative perfect adaptability in design, and, as a natural result, extracts practically all the ammonia, produces liquor of maximum strength, and removes the maximum of acid impurities at minimum cost.

SURFACE COMBUSTION BURNERS FOR BAKERS' OVENS.

In a note to the "American Gas Light Journal," Mr. H. L. Read, of the Surface Combustion Company, New York, remarks that the ordinary baker's oven can be easily converted for gas, all that is necessary being to cut a small opening in the wall, insert the burner, cement-up soundly, cover the grate with fire-brick for the reception of the refractory material, and connect the gas-pipes. This is exclusive of the fan or other arrangement for producing the air-blast. With gas at 3s. 4d. per 1000 c.ft. and coal at $6·25 per ton, the bare cost for fuel is nearly double; but the additional expense of gas is more than outset by advantages, such as the elimination of labour for firing up, clearing away ashes, &c., greater working capacity due to the fact that the oven can be more rapidly heated up, uniform temperature and complete control, increased cleanliness all round, no space required for coal storage, less repair on grate, furnace, and oven, and continuous operation. Also there is room for the cost to be kept down by intelligent working and management.

The best results are obtained if the outlet damper is closed at all times except for a few minutes after lighting-up, keeping a slight pressure in the oven that will be sufficient to secure the escape of the products of combustion through cracks round the damper, or a small hole made for this purpose. By arranging for a charge of pastry requiring lower temperature to follow a batch of bread which needs a strong heat, one firing can be made to suffice for two charges. Improved results follow the systematic use of reliable thermometers; but the bulbs must not be exposed to direct radiation from the refractory material, or in the line of passage of the flue gases.

The firing may be described as a continuous localized burning of a homogeneous mixture of gas and air in exactly the correct combining proportions required for complete combustion. Many ways of producing such a result are available, but for the present purpose the "impact" method is preferred, in which the heat is localized at a point where the speed of flame propagation equals that of the incoming fuel mixture. The mixing chamber and outlet nozzle are so proportioned as to secure this rate of velocity through the nozzle, and the issuing blast is directed on to the bed of refractory material, which consists of alundum or carborundum, and serves as a baffle for reducing the speed to admit of ignition, as a means of bringing the cold mixture up to ignition temperature, as a reservoir of heat, and as a source of radiant energy, combining the advantages of a gas-fire with those possessed by glowing coal or coke, with the disadvantages of neither.

Two burners mounted on a metal casing and properly bricked-in, with a lighting hole between them, were found to be the best arrangement. Gas at ordinary distributing pressure is admitted through a regulating cock to a pressure regulator, where it is reduced to atmospheric pressure, and passes on through an adjustable angle glove valve to a nozzle in the body of the burner casting, situated close to the narrowest part of a Venturi tube. The air supply passes from the blower through a regulating cock to an annular space surrounding the gas-nozzle, and its escaping velocity sucks-in the correct proportion of gas, and secures complete mixture before reaching the outlet nozzle. The construction and dimensions of the burner are so arranged that, no matter what amount of air is flowing through, the correct volume of gas is supplied, and the fire is controlled entirely by the air-valve, which is actuated according to the degree of heat required. The quantity of gas admitted at any one time varies in sympathy with, and remains in proper proportion to, the supply of air.

ESTIMATION OF NAPHTHALENE BY PICRIC ACID.

By DR. KNUBLAUCH, of Cologne.

A lengthy communication by Dr. Knublauch, of Ehrenfeld, Cologne, entitled "Studies of the Behaviour of Naphthalene towards Picric Acid and on the Exact Determination of Naphthalene, even in Warm Gas," appeared in the "Journal für Gasbeleuchtung" for Oct. 14 and 21 last. The following is a summary of its contents.

The method of Colman and Smith [*vide* "JOURNAL," Vol. LXXV., p. 798] for the estimation of naphthalene in coal gas depends on passing a measured volume of the gas through a known volume of standardized picric acid, which is trinitrophenol and forms with naphthalene a simple additive compound or picrate, and titrating back the excess of picric acid. Various precautions are necessary in order to obtain exact results. Dr. Knublauch refers to some of these, and then says that his work has been directed to clearing up points still in doubt and to presenting a trustworthy and simple method of determining naphthalene which should avoid the disadvantages ascribed to others.

QUESTIONS NEEDING SETTLEMENT.

The following were the points to be dealt with: (1) Can the use of undissolved picric acid be dispensed with, and the method be simplified by the consequent abolition of heating, &c.? (2) Can the whole of the picric acid combined with the naphthalene be determined instead of part by difference—say, by titrating the precipitate of picrate? (3) How can the precipitate of picrate be separated and washed quantitatively? (4) Can preliminary absorption of the ammonia be dispensed with, and the gas passed direct into the picric acid; the ammonia being retained by the picric acid or some added acid? (5) Subject to the solution of the last question, how can naphthalene be accurately estimated in hot gas?

THE PROPERTIES OF NAPHTHALENE PICRATE.

The author then studies the behaviour of picric acid towards naphthalene and the properties of the picrate. He arrives at the following conclusions: The picrate precipitated by naphthalene in a solution of picric acid is quantitatively decomposed at ordinary temperatures by a decinormal solution of alkali; and, consequently, the picric acid in the precipitate can be determined by titration as readily as free picric acid. The picrate is fairly rapidly decomposed by water. Consequently, in estimations of naphthalene, the picrate must not be agitated or washed with water. The picrate is insoluble in dilute picric acid, but is decomposed by a solution containing less than 0·16 p. ct. of picric acid. Hence in estimations the picrate should not be washed with a solution of picric acid more dilute than 0·2 p. ct. Even when naphthalene is in excess, there remains free picric acid of 0·16 p. ct. strength, whatever may have been the original strength of the solution. Thus the more dilute the picric acid used, the larger is the proportion which remains uncombined with the naphthalene; while acid of 0·16 p. ct. strength should remain unclouded when any quantity of gas containing naphthalene is passed through it. This explains the obscure effect of undissolved picric acid, the use of which has been recommended by some analysts. All that is necessary is that there should be an adequate excess in the final solution—say, 0·2 p. ct. of free acid. The inconveniently large quantities of solid picric acid sometimes used only cause trouble and want of exactness. On the other hand, there must be sufficient picric acid to provide for the naphthalene picrate and about 0·2 p. ct. of picric acid in the solution after dilution; otherwise decomposition of the picrate will ensue when the solution is diluted to a standard volume.

Gas containing very little naphthalene, if passed through picric acid solution of less than 0·4 to 0·5 p. ct. strength, does not cloud it; and if the strength is below 0·3 to 0·4 p. ct., the naphthalene passes through the solution and is not retained in any form, soluble or otherwise. The experiments which gave these results indicate that all the absorption cylinders should be charged with picric acid solution of about 1 p. ct. strength. The naphthalene which has separated in the liquid does not wholly combine with picric acid in 1 p. ct. solution when the latter is heated to 40° C. In one experiment, 77·7 p. ct. of the naphthalene was combined in one hour at 40° C.; less than one-third of the available picric acid in the solution being taken up. The picrate formed by passing gas containing naphthalene through 1 p. ct. solution of picric acid contains no free naphthalene. Where free naphthalene has been observed, it must have been liberated from picrate owing to the solution having been diluted below 0·16 p. ct. strength.

Benzene and phenol are not absorbed by picric acid. Phenol goes into solution, and, being washed out of the picrate when it is washed with 0·2 p. ct. picric acid, does not affect the titration, though it raises the result if the gas is passed directly into the solution for titration. Concentrated sulphuric acid diluted with four volumes of water and normal sulphuric acid do not dissolve or act on naphthalene. Consequently, dilute sulphuric acid may be used for preliminary absorption of ammonia instead of oxalic or citric acid. An addition of sulphuric acid greatly reduces the solubility of picric acid in water. Thus a mixture of 1 volume of normal sulphuric acid with 1·5 volumes of water dissolves only

one-third of the amount of picric acid which water dissolves. It was found by trial that more of the picric acid became available for combination with naphthalene when the acid was in solution in dilute (about semi-normal) sulphuric acid than when it was in aqueous solution; ammonia-free gas containing naphthalene being passed in excess through the solutions. The acidified solution also took up the naphthalene much more vigorously.

Naphthalene picrate, when heated in a solution of picric acid, decomposes to a greater extent the higher the temperature and the more dilute the solution. With solutions containing over 0·5 p. ct. of picric acid, decomposition of the picrate does not begin until the temperature exceeds 70° C. Picric acid solution of 1 p. ct. strength absorbs naphthalene well even at 50° C.; whereas solution of considerably lower strength only absorbs it at lower temperatures, while a weak solution acidified with sulphuric acid does not absorb unless the temperature is lowered somewhat further. A correction is necessary for the picric acid left on washing the picrate. If the solution used for washing contains 0·2 p. ct. of picric acid, and the filter paper is similar to No. 1 Whatman, a paper 80 mm. in diameter will retain 1·1 c.c. of the solution, or if there is 0·2 gram of picrate on the filter the volume retained will be 1·3 c.c., which corresponds to 0·1 c.c. of decinormal soda solution. This amount has therefore to be subtracted. The correction required for other sizes of filter will be $(\frac{r^2}{16} \times 0{\cdot}1)$ c.c., in which r is the radius of the paper in centimetres. The correction with filter papers of higher numbers will be smaller, and can readily be determined.

The foregoing results and deductions give the basis for a simple method of determining naphthalene, even in warm gas. It has been shown that it is unnecessary to use an absorption vessel containing acid in front of the picric acid vessels, since ammonia may be absorbed either by the picric acid itself or by dilute sulphuric acid added to it; also that it is not necessary to use any picric acid not in solution, while the picric acid equivalent of the absorbed naphthalene can be determined by direct titration of the picrate, instead of by difference, thereby giving equal accuracy with a smaller volume of gas.

Simplified Method for Cold Gas only.

Dilute sulphuric acid (1 part of acid to 8 parts of water) may be used in a preliminary absorption vessel to absorb the ammonia from the gas. An ample quantity of this acid is 25 c.c., except when the determination is made at the outlet of the naphthalene washer, where the gas sometimes contains much ammonia relatively to the naphthalene. In that case 50 c.c. or more of the dilute sulphuric acid may be needed—a few drops of methyl orange should be added to it to indicate that it is not neutralized. The first picric acid absorption cylinder should be of about 200 c.c. capacity, and about two-thirds of 75 c.c. of picric acid of approximately 1 p. ct. strength is put in it, and the remaining one-third in the second cylinder. The strength of the picric acid solution must have been exactly ascertained; and the cylinders are dried before filling. The absorption should be stopped when about 0·08 gram of naphthalene has been absorbed—with practice this may be judged from the quantity of picrate formed, or the volume of gas to be passed may be reckoned if its content of naphthalene is known approximately. Thus 800 litres of gas, containing about 0·1 oz. (43·75 grains) of naphthalene per 1000 c. ft. would be a suitable volume to use.

When the passage of gas is stopped, the picric acid solution in the second absorption cylinder is poured into the first; 50 c.c. of water is added; and the second cylinder is washed out with the mixture, the total volume of which is 125 c.c. It is then filtered, and 100 c.c. of the filtrate is titrated with decinormal alkali, using methyl orange as indicator. No free naphthalene occurs, and the difference (in c.c.) between the final titration and that of 60 c.c. of the original solution, multiplied by five-fourths and by 0·0128, gives the grams of naphthalene in the volume of gas passed through the absorption cylinders. Three examples of the use of the method are indicated by the author, who points out that it gives sufficiently good results whenever the quantity of naphthalene in the gas is not very small, but that it is not applicable to warm gas. Direct titration, however, is simpler and more exact than this method based on the difference on titration, and is applicable also to warm gas.

Quantity of Naphthalene in Crude and Clean Gas.

The author gives estimates of the quantities of naphthalene and ammonia which may be expected in coal gas at different points in the train of works' apparatus, as a guide to the quantities of picric acid and gas which should be used in making determinations. Samples of tar of different origin contained from 3 to 9 p. ct. of naphthalene. It may be assumed that the gas contains, in addition to this, about ½ oz. of naphthalene per 1000 c. ft., and the naphthalene formed in the retort should therefore be given by the following formula, in which a is the percentage (by weight) of the tar yielded by the coal, b the percentage of naphthalene in the tar, and c the cubic feet of gas per ton of coal:

$$\text{Naphthalene (oz. per 1000 c. ft.)} = \frac{3530\ a\ b}{c} + 0{\cdot}5$$

Thus coal yielding 10,000 c. ft. of gas per ton and 5 p. ct. of tar containing 6 per cent. of naphthalene would give gas containing as it leaves the retort:

$$\frac{3530 \times 5 \times 6}{10{,}000} + 0{\cdot}5 = 11{\cdot}09 \text{ oz. of naphthalene per 1000 c. ft.}$$

Actually the naphthalene formed in the retort ranges from 5 to 16 oz. per 1000 c. ft. of gas. The quantity diminishes, as the temperature falls during condensation, to a greater extent than corresponds with the fall, owing to much naphthalene being condensed with the tar vapours. Thus at 120° to 140° Fahr. the gas will contain only 1·3 to 2 oz. per 1000 c. ft., whereas for saturation at the former temperature over 5 oz. are required. After the tar has been almost completely deposited, the naphthalene begins to correspond with the saturation figure. Thus when the gas has cooled to 65° to 79° Fahr. there will be from 0·33 to 0·6 oz. of naphthalene vapour in 1000 c. ft. of gas. Immediately in front of the naphthalene washer there will be about 0·4 oz. of naphthalene. Owing to bad design and faulty supervision, naphthalene washers frequently are very inefficient, and 0·16 to 0·2 oz. of naphthalene is frequently present in 1000 c. ft. of the washed clean gas. On the other hand, if the naphthalene washer is properly designed on the counter-current principle, and is carefully operated, the gas leaving it will be practically free from naphthalene.

It is important to consider also the proportion of ammonia in the gas, with a view to deciding whether picric acid solution alone or acidified with sulphuric acid should be taken for the estimation of the naphthalene. The ammonia in the gas from Westphalian coal as it leaves horizontal retorts amounts to about 360 grains per 100 c. ft. In crude gas at 120° to 140° Fahr., it will be about half this amount. Immediately before and after the naphthalene washer, the proportion of ammonia present will depend greatly on the efficiency of the condensing, &c., plant. Out of forty gas-works, the author found in front of the ammonia washer, in sixteen works from 3 to 5 oz. of ammonia per 1000 c. ft., in sixteen works 2 to 3 oz., and in the remaining eight works less than 2 oz. Sometimes a good deal of ammonia is deposited in the naphthalene washers. While the gas should be free from ammonia after the ordinary washers, the author has frequently found quite considerable quantities, rising in an exceptional case to as much as 2·64 oz. per 1000 c. ft. This was reduced to 0·0053 oz. (= 0·23 grain per 100 c. ft.) by the passage of the gas through the oxide purifiers.

Appropriate Strength of Solutions for Tests.

Simple 1 p. ct. solution of picric acid may be used only when there is very little ammonia, because ammonia combines with 13½ times as much picric acid as naphthalene does. Wherever the proportion of ammonia is considerable, and in all cases when the gas being examined is warm, the first absorption vessel should be charged with a solution of picric acid acidified with sulphuric acid. Suitable proportions for this solution will be: 40 c.c. of 1 p. ct. solution of picric acid, 40 c.c. of normal sulphuric acid, and 30 c.c. of water. The second absorption vessel may be charged with 25 c.c. of simple 1 p. ct. solution of picric acid. The quantity of gas passed through must be insufficient to neutralize all the sulphuric acid in the first absorption vessel. If 110 c.c. of the acidified solution is taken, the volume of gas passed may be approximately 150 litres immediately before the naphthalene washers, or 50 litres at any point much nearer the retorts. Immediately after the naphthalene washers and in front of the ammonia washers, about 220 c.c. of the acidified solution should be taken in the first absorption vessel, and about 300 litres of gas should be used in the test.

Direct Titration of the Precipitated Picrate.

The second method, which is more trustworthy than the first and is applicable to warm as well as cooled gas, depends on the direct titration of the precipitated naphthalene picrate with standard solution of alkali. Two absorption cylinders, nearly 6 in. in height, and about 2 in. and 1⅜ in. inside diameter, with marks at 110 c.c. and 25 c.c. contents respectively, are used. With gas containing little or no ammonia, 1 p. ct. picric acid solution is used to the marks in both cylinders, and the gas is passed through at the rate of 50 to 55 litres per hour, the total volume passed depending, as before, on the proportion of naphthalene in the gas. With gas containing an appreciable proportion of ammonia, the large first cylinder is charged with 110 c.c. of the solution of picric acid acidified with sulphuric acid, for which suitable proportions have already been given, and the small second cylinder with 25 c.c. of simple 1 p. ct. solution of picric acid. The gas is passed through at the rate of 80 to 85 litres per hour; but this rate must be reduced when the solution in the second cylinder becomes slightly cloudy.

When the simple solution of picric acid only has been used, the contents of both cylinders are filtered through an 80 m.m. (3¼ in.) filter, the cylinders being washed out and the precipitate washed with 0·2 p. ct. solution of picric acid. Any particles of picrate left in the second cylinder after this washing out are washed with 50 to 80 c.c. of neutral water into the first cylinder, to which the filter with the precipitate is also transferred. One or two drops of methyl orange are added, and the contents are titrated with decinormal solution of alkali. By titrating in the first cylinder and stirring with the bubbling tube, any small particles of picrate clinging to the cylinder or tube are titrated. The titration is exact with a very sharp end point. The filter can alternatively be spread out on the inside of the cylinder and the precipitate washed off with water.

When there is sulphuric acid in the solution in the first cylinder, the contents of the second cylinder are first passed through the filter, and the cylinder and filter washed with 0·2 p. ct. picric

acid solution; then the contents of the first cylinder are passed through the filter and the precipitate is washed with 0·2 p. ct. picric acid until the washings are free from sulphuric acid. [The last washings, when heated with a little barium chloride, should remain clear for some time.] As the precipitate is small and porous, usually 100 c.c. of the 0·2 p. ct. picric acid solution suffices for washing the filter. The filter is transferred to the first cylinder exactly as in the first case, and the contents are titrated with decinormal alkali. In both cases, a deduction of 0·1 c.c. is made from the volume of alkali used, to allow for the 0·2 p. ct. solution of picric acid retained by the filter paper and precipitate. The number of c.c. of decinormal alkali found, multiplied by 0·0128, gives the amount (in grams) of naphthalene in the volume of gas passed through the solution.

The author gives a number of examples of the use of this method for the determination of known quantities of naphthalene; and the results are in close agreement with the amounts taken, whether ammonia is absent from or present in the gas.

Comparison of the Two Methods.

The second or direct titration method has the great advantage of being applicable to warm gas, which the first or differential titration method is not. Moreover, phenols and hydrocyanic acid in the gas have no disturbing effect in the second method, whereas in the first they cause an uncertainty which increases with the volume of gas used in the test and, consequently, is greatest when the naphthalene to be estimated is at its lowest. When 0·0875 gram of naphthalene was volatilized in gas free from naphthalene, the first (differential) method gave 0·0889, and the second (direct-titration) method 0·0858; while when 0·0822 gram was similarly taken, the methods gave 0·0818 and 0·0781 gram respectively. In this case, there is fair agreement; but in other cases in which gas which had not previously been freed from naphthalene by means of picric acid, and consequently deprived also of phenols and cyanogen, was used, the differential method gave considerably lower results than the direct titration method. If, however, the phenols and cyanogen are first abstracted by passing the gas through water containing ferrous sulphate precipitated by alkali, and ammonia is then removed by dilute acid, the first method also gives good results. Phenols, cyanogen, and ammonia may be abstracted in one absorption vessel if there is considerable excess of iron, whereby the insoluble ferrocyanogen compound which absorbs ammonia is produced. A suitable mixture to use is 10 c.c. of 1 p. ct. solution of ferrous sulphate and 9 c.c. of normal solution of caustic potash or soda, diluted to 25 c.c. With such a preliminary absorbent interposed, the differential method gave 0·0736 gram of naphthalene when 0·0730 gram was found by the direct titration method. In these tests the volume of gas passed through the solutions was 1000 litres; and the above results show that very satisfactory agreement between the two methods is attainable even with so large a volume.

CALCULATING THE WEIGHT OF STEEL IN TANKS.

To a recent number of the "Gas Age" (New York), Mr. W. F. Schaphorst, an Engineer of New York City, contributes a pair of charts [here reproduced] which will be found useful for determining the weight of metal in a steel tank.

Chart No. 1 is for finding the weight of the sides or cylindrical parts, and Chart No. 2 is for the flat ends or the top and bottom. To use the charts is, he says, a simple matter.

Example: How many tons of steel are there in a tank 100 ft. high × 100 ft. dia., if ½ in. metal is used throughout?

First use Chart No. 1. Connect the 100 (Column A) with the 100 (Column E), and locate the intersection with Column B. From the point of intersection run over to the 0·5 (Column D); and the intersection with Column C gives the tonnage, as about 285 tons. On account of the overlapping plates, joints, rivets, &c., this figure is not absolutely accurate; but it is close enough for all practical purposes, and the usual percentage can be added to make up for the joints and other surplus metal.

To use Chart No. 2 for circular plates. Connect the 100 (Column A) with the 0·5 (Column C), and Column B gives the weight of a flat plate of those dimensions as very close to 71 tons. If the top and bottom are both ½ in. plate, the total for the top and bottom will be 142 tons, *plus* the percentage for joints. The weight of the whole tank, therefore, is 285 + 71 + 71 = 427 tons.

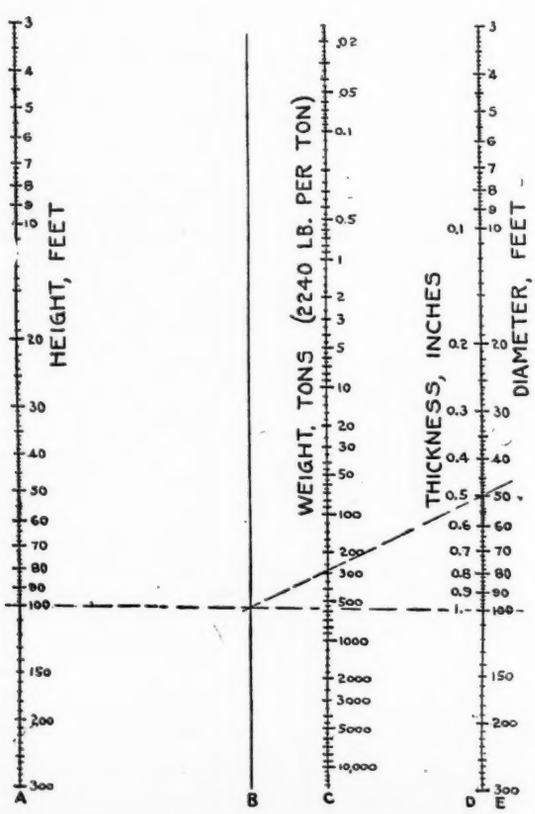


Fig. 1.—Weight of Cylindrical Shell.

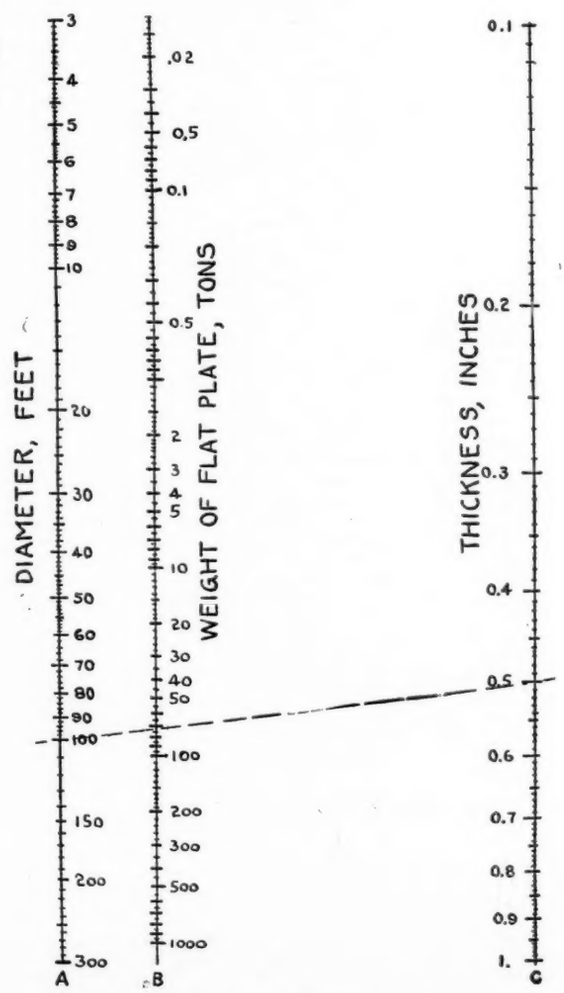


Fig. 2.—Weight of Circular Plates.

REGISTER OF PATENTS.

Distilling Carbonaceous Material to Produce Smokeless Fuel and Recover Bye-Products.

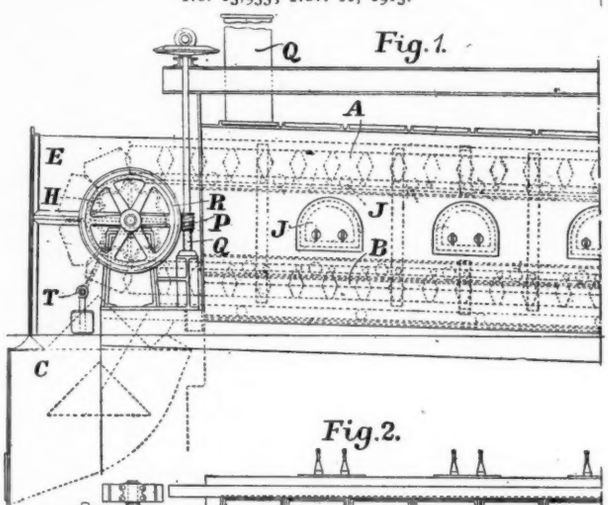
RICHARDS, R. S., of Woodford, Essex, and the SMOKELESS FUEL SYNDICATE, LTD., of Leadenhall Street, E.C.

No. 15,933; Nov. 11, 1915.

This invention is said to form an improvement to the apparatus described in patent No. 15,643 of 1909, granted to R. S. Richards and R. W. Pringle.

The plant employed comprises: Upper and lower longitudinal tubular chambers (surrounded by a masonry or other suitable structure); an external chamber at each end of the apparatus connecting the tubular chambers; a wheel or drum in each of the external chambers, adapted to carry a chain conveyor, on which are mounted trough-like sections, which throughout their traverse overlap and co-act to form one or more continuous furrows or troughs without disengaging, and which pass through the upper and lower tubular chambers; combustion chambers disposed between the upper and lower tubular chambers; means for taking-up the slack in the conveyor; means for filling the conveyor at one end and discharging the conveyor at the other end; means for taking off the products of distillation; and means for travelling and operating the conveyor.

Fig. 1.



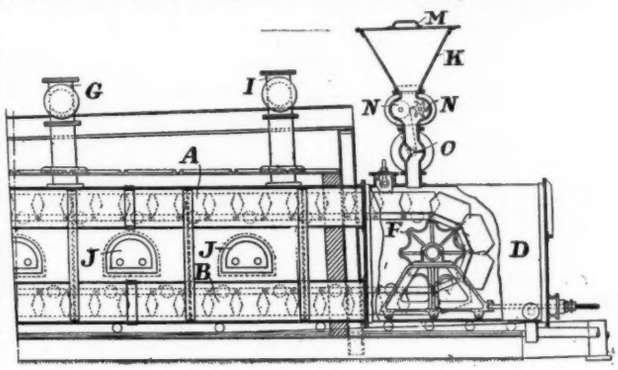
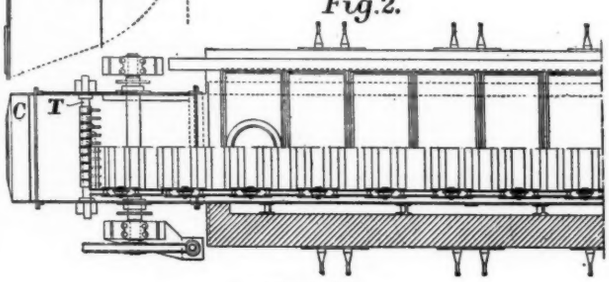
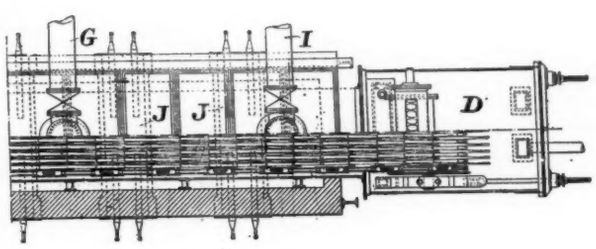


Fig. 2.





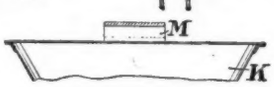


Fig. 3.

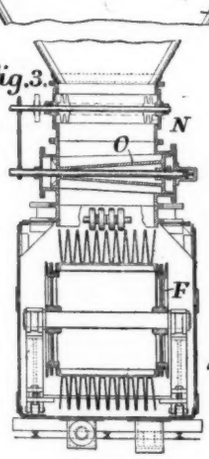
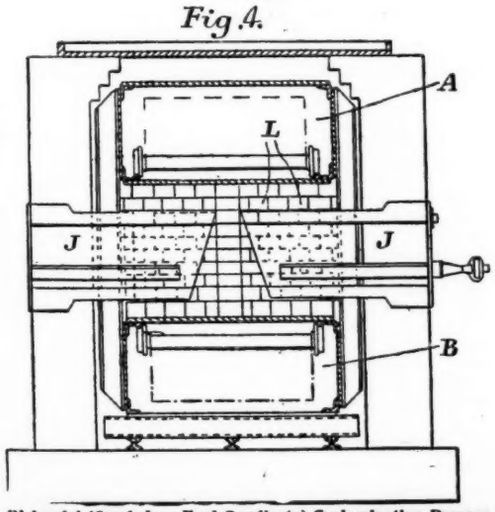


Fig. 4.



Richards' (Smokeless Fuel Syndicate) Carbonization Process.

The heating of the chamber to bring about the carbonizing is so arranged as to permit of employing regular temperature throughout its entire length, or, alternatively, a varying temperature throughout portions of its length, by means of combustion chambers arranged between the upper and lower tubular chambers fed with gas and air for combustion, either (in the case of a single unit) through the side walls, or (in the case of multiples) by the passage of the gas and air pipes through the division wall into the combustion chambers with regulating devices for bringing about combustion, either collectively or separately at any number of points.

The heat arising from the combustion is, by conduction and radiation, made to come in contact with the lower part of the upper tubular chamber, the sides, and finally the crown of the chamber, on its way to the exit flue.

Fig. 1 is a longitudinal elevation partly in section showing one form of the apparatus. Fig. 2 is a plan. Fig. 3 is a cross section through the feed-device and end chamber. Fig. 4 is a cross section of the tubes and furnace.

A is the upper and B the lower tubular chamber, connected by framing. D is an external chamber at one end (connecting the two tubular chambers) and E at the other end. In the chamber D is a polygonal wheel F mounted in a carriage; while a similar wheel H is mounted in the chamber E. A chain conveyor passes through the chambers A and B and over the wheels F and H. A feed hopper K, with a self-closing door M, has below it a pair of feed rollers N; and below the rollers is a chambered valve O adapted to discharge the material to be carbonized on to the chain and prevent the escape of gas through the valve. P is a worm adapted to gear with a worm wheel R in the chamber E for the purpose of travelling the conveyor. There is a series of prongs mounted on a shaft T counterbalanced by weights. C is a discharge hopper, into which the carbonized material is deposited when it leaves the conveyor, with a cone valve adapted to close the exit. A self-sealing door is fitted in the discharge hopper, and, together with the door M, serves to keep the apparatus closed and permit of its being worked either below or above atmospheric pressure. The conveyor is formed of troughs fluted longitudinally, the rear end of the leading trough lying within the forward end of a following trough when travelling through the upper tubular chamber; the material to be carbonized lies in the flutes of the troughs which form longitudinal channels. G I are exit pipes for taking off the products of distillation from the upper tubular chambers. J are combustion chambers disposed between the tubular chambers A B. They are heated by burners fed with gas, or in any other convenient manner. The products of combustion from the combustion chamber circulate through vents L into the space between the chambers A B and the walls of the surrounding structure, and are then directed over the upper chamber and out by the flue Q.

In operation, the material to be carbonized is deposited in the hopper

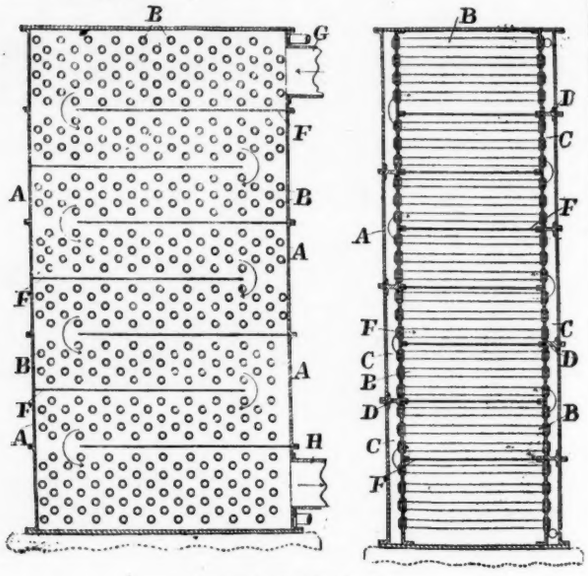
K and fed on to the troughs of the conveyor, which is traversed slowly through the chamber A, which is heated by the products of combustion arising in the chambers J. As the conveyor passes over the wheel or drum, the "individual sections of the troughing, by reason of the change of motion from horizontal to circular, partially disengage, breaking the carbonized core at the lines of intersection, and, by reason of their tapering formation vertically and longitudinally, discharge their contents, which fall into the discharging hopper C, which is periodically cleared of its contents or can, by means of a submerged conveyor, be automatically discharged."

Condensers for Gas.

VANSTON, T. A., of Bolton, Lancs.

No. 16,416; Nov. 22, 1915.

This condenser is of the type wherein the cooling medium is conducted through series of zig-zag pipes, while the gas travels a zig-zag path at right angles. The invention consists in arranging the series of pipes for the cooling medium so that they communicate with one another by spaces between the plates forming the double walls of the apparatus.



Vanston's Gas Condenser.

A sectional side elevation of the condenser (certain parts being omitted for the sake of clearness) and a sectional elevation at right-angles are given.

The condenser consists of an outer casing within which are inner walls extending across or throughout the depth of two sides or ends—thus leaving compartments C between the casing and the walls. In these walls are series of tubes B, leading into the spaces C, which are divided into compartments by the spacing pieces or diaphragms D—bars of metal of H-section. Thus liquid, passing upwards through the tubes B, will flow zig-zag through each series of the tubes (say) from the inlet at the lower end to the outlet at the upper end. Each space, with the exception of the highest and lowest of the series, is common to two series of tubes. Intervening between each series of tubes B is a baffle or diaphragm F extending partially across the apparatus; sufficient space being left between its outer end and the wall to allow the gas to pass from the upper end of the apparatus (to which it is fed by the tube G) in a zig-zag path to the lower end, where it is led from the outlet H to any convenient point desired.

As the cooling medium (such as water under pressure) is admitted to the lowest compartment C, it will be forced upwards through the different series of tubes B in a zig-zag path—being caused by the diaphragms D blocking its progress and causing it to flow as desired; while gas admitted through the pipe G will follow a sinuous course in a downward direction, guided by the baffles F to impinge upon the different series of tubes B until it finally emerges at H. Consequently the paths travelled by both the liquid or cooling medium and the gas to be acted upon are at right angles to each other.

Gas-Furnaces.—No. 102,318.

YATES, H. JAMES, of Aston, Birmingham, and BRAYSHAW, S. N. & E. R., of Hulme, Manchester.

No. 5333; April 12, 1916.

This invention relates to furnaces heated by gas in which secondary air is heated to a high degree before entering the combustion chamber or coming into contact with the flame.

The patentees remark that, in this class of furnace, it is well known to provide air passages in the walls and floor of the furnace in which the air is heated (tending, however, to reduce the temperature of the furnace by robbing the heat from it), and also to provide below the floor of the furnace flues for the waste gases in which transverse air conduits are placed in which the air has been heated. Their invention is designed to provide a furnace in which a secondary air supply is heated solely by the waste gases after their useful effect in heating the furnace has been exhausted, and in which only a limited amount of primary air is admitted unmixed with the gas to partially support combustion and to cause the gas to burn with "a smoky or greasy flame which will not have an oxidizing effect." This construction, while heating the secondary air to a high temperature, will not have any cooling effect upon the sides or bottom of the furnace.

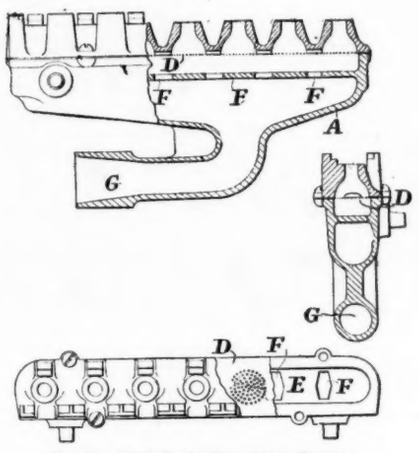
The invention consists in the particular arrangement and disposition of the exhaust flues for the waste gases, the air passages for the secondary air, and the gas jet or burner, with a chamber for the primary combustion of the gas fuel.

Gas-Fire Burners.—No. 102,510.

DAVIS, H. N., and TWIGG, W. R., of Luton.

No. 75; Jan. 3, 1916.

This invention refers more particularly to burners for gas-fires and the like, comprising: A lower body portion divided by a horizontal baffle-plate or partition into an upper and a lower chamber; an upper cover portion having interconnected nozzles upon which the flame burns; and an intermediate gauze or perforated partition clamped between the upper and lower portions. The invention consists in the provision of a single or duplex burner chiefly distinguished by the arrangement of the burner nozzles in a straight line above a horizontal baffle-plate provided with a plurality of holes arranged in staggered relationship to the nozzles.



Davis and Twigg's Gas-Stove Burner.

A sectional elevation of the burner is given; also a plan view (with parts broken away), and a transverse sectional view.

The burner is of such construction that it "materially assists in bringing about an intimate mixture of the gas and air supplied and at the same time gives an even length of flame at all and each of the burner nozzles." To this end, the lower portion A is provided with an intermediate horizontal baffle-plate or partition E—in effect, dividing the mixing chamber into two compartments, which communicate with each other by a plurality of large orifices F disposed out of alignment with the burner orifices. The intermediate space above the plate E and below the perforated plate or gauze D "serves as an expansion chamber, and has a silencing and steadying effect on the flames." The supply tube G is formed in one with the lower casting, so as "at its outer end to co-operate with any convenient means for the introduction and regulation of the combustible mixture." All of the orifices of the nozzles are connected by passages so as to equalize the pressure of the gases issuing from them.

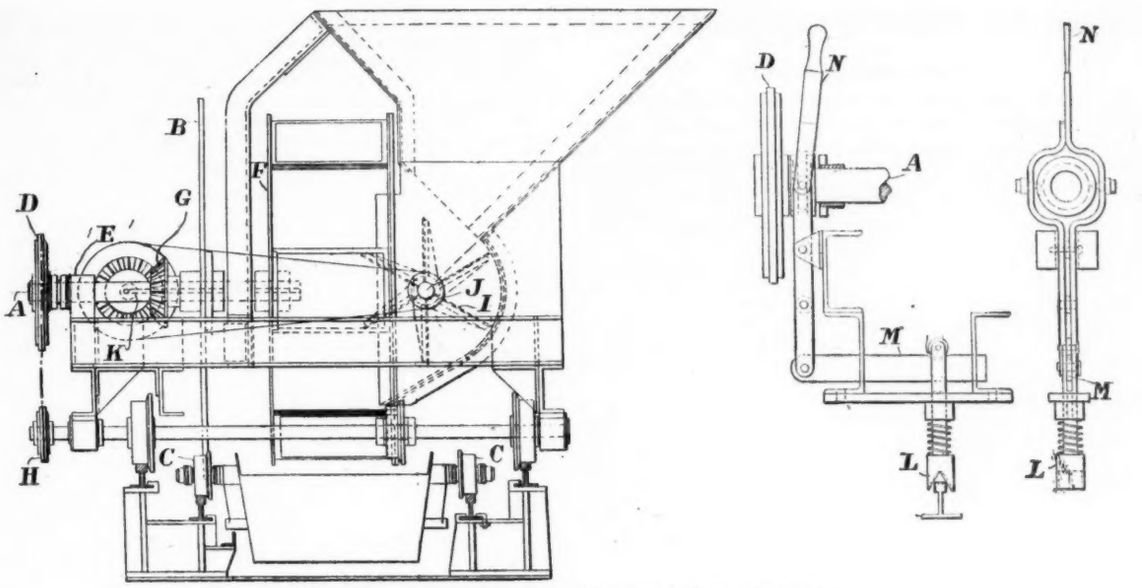
Shoots for the Delivery of Coal, Coke, &c., to Conveyors.—No. 102,535.

TOOGOOD, H. J., and ROBERT DEMPSTER & SONS, LTD., of Elland.

No. 1624; Feb. 3, 1916.

This invention relates especially to travelling feeding shoots for receiving coke from gas-retorts, and coal from coal-stores, and delivering to conveyors of the gravity bucket type.

It has been proposed, the patentees remark, to provide such machines with delivering and measuring mechanism geared to the conveyor chain, and with hand-operated bolts for locking the machine in its required position; also to provide a handle on the rotary shaft of the mechanism, so that by applying manual power to the handle, the machine itself could be caused to travel either with or against the conveyor. But, according to this invention, to save the work of the attendant and to ensure the locking of the machine in the desired position, suitable gear is provided as follows: Normally a spring actuated brake V block engages the rail, which may be notched at the desired stopping places. A jaw clutch and gearing are also provided on one of the shafts rotated by the motion of the conveyor. The operating lever is so arranged that in the central or normal position the clutch is disengaged, and the spring rail brake applied, whence the machine is stationary with its parts rotating for the purposes required. The action of throwing the lever over to one side—say, to the right—simultaneously disengages the rail-brake and causes the clutch to engage a clutch member fixed to the framework of the machine, thus stopping the rotation of all rotary parts of the machine,



Toogood's (R. Dempster and Sons) Travelling Coal-Feeding Shoots.

"so that it is carried along by the chain and traverses the house with the conveyor chains, and at the speed of the conveyor—say, 47 ft. per minute." The action of throwing the lever over to the left hand from the central position releases the rail brake and clutches the rotating shafts to the axle of the machine, so that the machine is traversed in a contrary direction to that of the conveyor at a speed of (say) 30 ft. a minute.

A rear elevation of a machine of the drum filler type is given, with portions of a coal-bunker; also elevations, at right angles to one another, of the clutch or locking mechanism.

On a shaft A is secured a large toothed ring B, engaged and driven by the conveyor chains C; and on the same shaft is mounted the sliding member of a jaw clutch, adapted to be engaged either with the boss of a chain wheel D or with a corresponding clutch member attached to the fixed pedestal E. The shaft carries the filler F and a bevel pinion G. The wheel D is operatively connected to another chain wheel. Below the hopper is a feeding device comprising a number of radial blades I on a shaft. The material flows from the hopper at nearly the natural angle of repose—the blades lying in the stream of such flow, so that when the feeding device is at rest no material can pass from the hopper. Hence "the rotation of the blades governs the quantity of material passed, without shearing or compression of the material; and the feeding shaft being geared to the conveyor, the rate of feed is always correlated to the speed of the conveyor." The shaft has a pulley J driven by a slack belt from a pulley on the end of a cross shaft carrying a bevel pinion in gear with the pinion G. The belt is set to slip at a predetermined load; so that the blocking of the feed—say, by a piece of timber or iron among the coal—does not of necessity traverse the machine, but simply overcomes its frictional drive.

The shank of the spring brake block L carries a bowl adapted to register in a recess M in a bar in such manner that the movement of the bar either to right or left raises the bowl and brake block. The handle N, which throws the jaw clutch, at the same time actuates the bar. Thus when the clutch is engaged with the boss of the wheel D, the spring brake has been raised and the wheel drives the axle of the machine as previously described, so that the machine travels against the conveyor; and, conversely, the engagement of the clutch with the lugs or clutch members forming a part of the pedestal E locks the rotary parts so that the machine travels with the conveyor.

Gas-Producers.—No. 102,597.

THUMAN, F., of 38, Victoria Street, S.W.

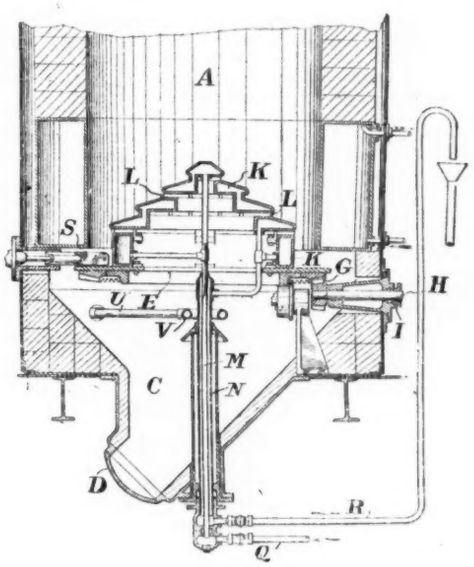
No. 13,178; Sept. 16, 1916.

This invention relates especially to water-gas producers, of the kind in which the ashes and clinker are mechanically removed from the base of the producer by a rotating base-plate on which is mounted a grate that projects into the fuel bed and serves as an ash crusher.

The illustration shows (in sectional elevation) the lower portion of a water-gas generator constructed according to the invention.

A is a cylindrical fire-brick-lined fuel chamber, with a water-cooled lining at the lower section (which is usual practice). The chamber is extended below the grate to form the hopper-shaped ash chamber C, with discharge door D. The annular iron base-plate E is supported upon wheels rotated by spur gearing G and shaft H, which passes through the side of the ash chamber by a packed gland, and is driven in any suitable manner. Upon the base-plate is mounted the grate, which is formed with water-circulating channels K, and with openings L for the distribution of air and steam to the fire. Depending centrally from the upper part of the grate is a straight pipe M, also connected to the hollow cylindrical portion of the grate by a branch. Surrounding it, and attached to it just below the grate, is a pipe N, which is connected to the two sections of the grate and extends through a stuffing box fixed to the wall of the ash chamber.

The cooling-water is brought under pressure through an inlet main Q into the lower compartment, and passes thence, through the pipe M, rotating with the grate into the passages K, while the effluent water is taken from the passages K by the pipe N, and passes into the upper compartment of the junction box and thence through an outlet main R,



Thuman's Water-Gas Producer.

the discharge end of which is above the level of the grate. The ash rake S is adjustable from the exterior of the producer. The air-blast to the generator is supplied through a valve controlled inlet, and the steam by the pipe U and sprayer V.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for Dec. 30.]

Nos. 18,441—18,686.

ADAM, W. G.—"Fractional distillation." No. 18,671.
CHAMBERS, C. E. & E.—"Gas-fires." No. 18,456.
COMPAGNIE GENERALE DE CONSTRUCTION DE FOURS.—"Manufacture of gas." No. 18,581.
CUMMING, A. C.—"Manufacture of trinitrotoluene." No. 18,471.
FRASER, J. K.—"Skips for carrying coal, coke, &c." No. 18,654.
HEELEY, G.—See Compagnie Générale. No. 18,581.
IONIDES, A. C.—"Furnaces." No. 18,546.
KEIGHLEY, W.—"Burners of gas stoves, fires, &c." No. 18,604
KEITH, G. & J.—"Gas heated soldering irons." No. 18,445.
KEITH, G. & J.—"Gas-lighting torch." No. 18,659.
LEWIS, G. P.—"Production of oxides of nitrogen." No. 18,473.
POORE, P.—"Destructive distillation of wood, &c." No. 18,523.
ROMANES, J. W.—See Cumming. No. 18,471.
WALKER, J.—See Cumming. No. 18,471.
WALTON, M. & W.—"Tap for gas, water, &c." No. 18,641.
WILSON, W.—"Coke discharger." No. 18,570.

LONDON AND SOUTHERN JUNIOR ASSOCIATION.

A Meeting of Varied Interest.

It was arranged at the last annual meeting that, in view of the fact that so many members are away on active service, there should be only one meeting held during the present session. This took place on Friday evening at the Westminster Technical Institute, Vincent Square, S.W., when there was quite a large amount of discussion—especially when taking into account the somewhat poor attendance. The first item on the *agenda* consisted of "Notes on Combustion Methods in the Laboratory," by Mr. J. Hewett, which will be found on p. 72. There were light refreshments at the invitation of the President, followed by more or less informal consideration of other matters here referred to.

Mr. S. B. CHANDLER (the President), of the South Suburban Gas Company, in opening the proceedings, remarked that, in view of the unsatisfactory state of the finances of the Association, owing to the fact that so many members had joined the forces, it had been decided that the Hon. Secretary (Mr. George Winslow) should write a letter to the patrons and point out the position. This had been done, and he was happy to say the response had been very good. The amount received up to date was £18 15s., which he thought was excellent testimony to the high regard in which the Association was held by the patrons. The congratulations of the members would be extended to their past President, Mr. W. J. Liberty, who had obtained a Commission in the R.N.V.R.

QUESTIONS AND ANSWERS.

Several questions which had been sent in by members were submitted to the meeting for answer; and some of the opinions expressed are briefly noted, with the questions that elicited them.

Furring of hot-water apparatus. Is there any practical way of removing the lime deposit other than by chipping it off; this method being disastrous to thin copper apparatus?

The PRESIDENT said that in the Midlands a lot of trouble had been experienced with hard water; and he believed that in the case of one corporation no circulators were fixed unless they had a manhole so arranged that they could easily be got at for chipping. Was there any other method than this?

Mr. J. G. CLARK (Gas Light and Coke Company) remarked that he had heard of crude hydrochloric acid being used—more particularly in connection with cast-iron apparatus, though probably there would not be any harm in using it with copper. He had tried it, but had not formed a very high opinion of it; but he understood it was employed a good deal in the North and the Midlands.

Mr. W. L. WESTBROOK (North Middlesex Gas Company) alluded to the claim made on behalf of a paint, that it prevented the lime deposit adhering to the surface of the metal. The deposit simply fell of, and remained at the bottom of the boiler.

Mr. E. G. STEWART (Gas Light and Coke Company) suggested that pure graphite in the boiler would stop the scaling.

Mr. W. E. BROWN (Gas Light and Coke Company) pointed out that some of the apparatus largely used for boiling water for tea in big quantities got into a very bad condition, if not regularly attended to.

Mr. J. HEWETT (South Metropolitan Gas Company) said that a great difficulty in London was that, since the Metropolitan Water Board had taken the supply over, it was impossible to depend upon the condition of the water in the matter of hardness.

Mr. F. A. FROST (South Metropolitan Gas Company) pointed out that much of the difficulty Mr. Brown referred to was due to the fact that the water was boiled over and over again.

Mr. F. AINSWORTH (Ilford) claimed that geysers would have to be made so that they could be easily taken to pieces.

The PRESIDENT remarked that there were now geysers on the market which complied with this condition.

Which is the better practice, (a) to supply stoves and other apparatus to consumers rent free and spread the cost over the whole of the consumers, or (b) to charge a rent for each apparatus? Is it desirable from a company's point of view to fix stoves and other apparatus free of charge?

Mr. HEWETT said this was entirely a matter of policy.

Mr. AINSWORTH, while believing in doing things as cheaply as possible, urged that, as commercial undertakings, they had to ask themselves whether a certain course would pay. In the case of new estates where his Company had put in pipes for lighting, they took good care to fit up a supply for the fireplaces and for a geyser. This had been very successful. Scarcely a geyser had been put in without selling another; but this had been because the pipe was already fixed. Many undertakings could no doubt do more than they had done in the way of providing facilities; but to put in everything free seemed to him to be a mistake. Of course, the district in which the gas-works were situated had to be considered.

The PRESIDENT agreed that local conditions must determine the question. Speaking personally, he did not think one should do things altogether free, because perhaps a consumer did not value what was given to him so much as what he had to pay for. The whole point, however, was that they must get in. There was no reason why new estates, where gas was cheap and electricity was an average price, should not be all carcassed for gas, for lighting, fires, and hot-water supply.

Mr. WESTBROOK pointed out that, in determining whether a course would pay, the cost and life of the apparatus should be considered, as well as the consumption of gas. If a person wanted (say) a fire, he would not mind paying something for it. It should be a small charge, but sufficient to ensure that the hirer would use the apparatus when he had it.

Where should the air be introduced into oxide purifiers?

Mr. FROST said he thought the obvious reply to this question was, "At that point where it was required."

Mr. HEWETT thought perhaps the intention of the member who put the question was to ask where the air should be admitted which was used for oxide purification. The proper place with oxide purifiers was actually at the purifiers; and the air should be measured so that some real control could be exercised over it.

Mr. STEWART remarked that if the air was admitted on the pressure side of the exhauster, it had to be pumped in; and for this reason small works must put it in before the exhauster. In large works, it was preferable to admit the air after the cyanogen plant. He did not see any necessity to put it into individual boxes, because with the rotation systems it was claimed that the revivification only took place in the boxes that were dirty. No one should attempt to put air into purifiers without measuring.

Mr. W. F. BROWN (Commercial Gas Company) said that it was of assistance if the air was put in with a steam-injector. The moisture got carried on into the oxide, which would last much longer; and it helped to obviate the risk of firing. With the Williams cyanogen process, the air was allowed to go in before the cyanogen extractor, so as to revivify the oxide of iron.

GAS SALESMEN AND GAS EXAMINATIONS.

The short time which remained to the meeting was devoted to debating the questions of the training of the gas salesman and the existing system of examination.

The PRESIDENT, in opening the discussion, said that many radical changes in the technics and uses of gas had made themselves apparent during the past year or two; and the need for commercial experts in the industry had increased. The many new uses for gaseous fuel which had been opened up rendered its correct application a matter of great importance, and made the technical representative a valuable asset to his undertaking. On his alertness and advice the stability and well-being of the company to a large extent depended; and he would be a bold man indeed who would deny that the high position occupied to-day by the gas industry was largely attributable to the energy and efforts of the outside man. These new applications of gas for multifarious purposes called for a degree of specialization previously unforeseen, but now fully recognized; and to this end, the excellent series of gas-supply classes, lectures, demonstrations, &c., were doing a great work, and must extend the usefulness of the gas salesman. Their value was admitted; and efforts in this direction should in no way be relaxed. The knowledge imparted, however, while very necessary, was of a general character—covering mains, meters, lighting, heating, hot-water supply, power, chemistry as applied to lighting and heating, gas and electric competition, &c. A varied syllabus of this character could necessarily form only the foundation—admittedly of considerable use—on which to build a special course of study. It appeared to him, therefore, that the different subjects should, within limits, be further split up, amplified, and extended, in such a way as would allow the student to confine his attention to the one particular matter to which he might desire to specially devote himself, and thus, by examination, render himself expert upon an individual subject. The need for specialists in all work which was the object of acute competition was a growing one. For instance, hot-water supply, different forms of power, furnace and industrial operations, and heating and ventilating problems, all called for expert attention, and must receive it, if the sound position occupied by the industry to-day was to be maintained. Unlike almost any other, the gas industry exercised a particular influence over the welfare of the "man in the street," and contributed largely to his comfort and happiness. Each season produced some new apparatus, and led one to suggest that the most efficient service could only be rendered by special staffs of men in possession of particular knowledge, apart from that sufficient to "carry through" the ordinary gas inspector and canvasser. The trend of events was indicated by the action of a number of large companies, who had of late opened-up sections, coming within the sales-of-gas department, made up of one or more experts, whose business it was to take over special work, and who were expected to deal technically, with considerable benefit to consumer and company, with matters upon which they had particular knowledge and training. The idea was not a new one; but it should be realized that the demand for the expert was bound to increase. The thought he had in mind was that at the moment there did not appear to exist any set scheme or course of study which would produce an official who (by certificate) would be in a position to regard himself as an expert in any special branch on the commercial side of gas supply. One might possibly except the hot-water and power aspects; for greater attention had perhaps been given to these very important branches than to others coming within the scope of his remarks. Shortly, then, if they admitted the need for expert tuition, resulting in the production of "single-subject" men, as apart from the all-round type, there appeared to be no tangible reason why, after the war, there should not be brought about special courses of

study which, while embracing the more general knowledge, as at present, would qualify for particular subjects. It might be argued that there already existed a large number of subjects dealing with different phases of the industry; and, of course, one had only to glance at (say) the programme of the Technological Department of the City and Guilds of London Institute to observe this. But viewing the importance of the distribution side of the business, the ever-increasing competition (which would become still more acute), the many novel uses to which gas was now put, and the demand by the consumer for expert attention and advice (which was certainly due to him), efforts ought to be made to amplify and extend the "Gas Supply" syllabus, and render possible the obtaining of evidence of theoretical and practical training in one of the special subjects he had in mind. The co-operation of the educational bodies would naturally be obtained. Such authorities as the City and Guilds of London Institute and the London County Council had always been good friends to the gas industry, and so would lend a sympathetic ear to any suggestions in this direction that might be made. It might be that after the war the conditions of industry would call for drastic alteration in methods of business, and a speeding-up. They could, however, be certain that new conditions would mean renewed effort to overcome the problems and difficulties which must arise; and they should, therefore, be prepared to meet any such contingency.

Mr. CLARK remarked that the question of examinations was a very important one; and if instruction was to be carried out with thoroughness, it must be taken into account. To his mind—and he had had a good deal of experience with students—one of the serious defects of the examination system as conducted to-day was that any opinion that the instructor might be able to express was entirely excluded. What he meant was this. During the session, the instructor might find that some students succeeded through possessing rather more than average acuteness, while others persevered, and "got there," more because they were earnest in their study. These two kinds of students, under examination, might show results altogether different from the actual facts; and the instructor, with personal knowledge of the candidates, would be able to avoid this. The answers as they stood might be a long way from being an index to the ability of the student; and therefore it would be well to consider whether the teacher should not have a word in the awarding of the certificates.

Mr. HEWETT said he thought everyone who knew anything about students and their different capacities was convinced that the teacher really ought to have something to say in the matter. After all, it was the man who did things that was wanted more than ever nowadays. There was a good deal of fortune and misfortune about examinations; and it was not always the best man who passed. The candidate at the bottom of the list might, if he were only given an opportunity of showing what he could do, "knock spots" off the man at the top; and the teacher, coming into personal contact with the students, would be able to judge of this. Therefore Mr. Clark's suggestion that the instructor should have some voice in the awarding of the certificates seemed to be a good one.

Mr. STEWART expressed the opinion that a lot of the trouble about men who really did know coming out badly in examinations was due to one thing—namely, that they had never been taught how to answer questions. Out of a course of lectures, it would pay the teacher to set apart one for showing the students how to deal with their examination paper. To his mind this accounted largely for the extraordinary success of correspondence classes. The great thing was for the gas salesman to have a note-book, and to keep it up to date, from the Technical Press and knowledge gained by his own experience.

Mr. AINSWORTH agreed with the suggestion that better results would follow if the teacher had a "say" in the matter of examination awards.

Mr. HEWETT remarked that a very good case had been made out for the expert in certain directions.

Mr. STEWART asked who would pay the experts. Should they be supplied from a central institution, or should the companies themselves provide them?

The PRESIDENT said there were plenty of companies who would take them up. Of course, it did not follow that because a man was a specialist in one thing, he could not do other work.

Mr. WESTBROOK said modern practice was developing towards specialization in the larger undertakings; but the smaller concerns might not have enough work for them—except in connection with hot-water work. He was absolutely convinced it would pay any undertaking, however small, if there were gas-engines on the district, to send a good man round to see that the consumers obtained the highest efficiency, which in many cases they did not do now.

The PRESIDENT referred to an instance of a large company who had employed an outside man to go round and visit the power users on the district and advise them, without any charge, whether they were getting the best results from the fuel. It would, he thought, be better for the companies to do this themselves.

Mr. WESTBROOK added that for furnace work, in districts where there was an opening for it, it was essential to have specialists. It was useless to send a man to get an order for a furnace unless he could discuss the money side of the question; and it was also useless to send a man to fix the apparatus unless he knew how to secure the maximum efficiency. For the smaller undertakings, there ought to be some combination, so that any one of them could get a man for a certain job.

SALES OF SULPHURIC ACID.

Maximum Prices Fixed.

The Press Bureau state that a circular-letter was issued on the 30th ult. substituting, as from Jan. 1, 1917, the following maximum prices for sales of sulphuric acid, for those set forth in circular-letters of Feb. 11 and 28, 1916. These refer to sales of sulphuric acid of all descriptions, and for all purposes unless expressly excepted.

		Maximum Price per Ton for Acid delivered into Tank-Wagon, Cart, or Barge at Makers' Works.
Class A.—Arsenical acid . .	140° Tw. at 60° Fahr.	70s.
Class B.—Non-arsenical or de-arsenicated . . .	144° Tw. at 60° Fahr.	85s.
Class C.—Arsenical	95 p.ct. H_2SO_4 . .	130s.
Class D.—Non-arsenical or de-arsenicated . . .	95 p.ct. H_2SO_4 . .	140s.

Recommendations are also made as to allowances for variation in strength, charges for filling and hiring of packages, &c.

Further particulars on these points, and copies of the circular-letter referred to, can be obtained upon application to the Director of Acid Supplies, Ministry of Munitions of War, Explosives Department, Storey's Gate, Westminster, S.W.

GAS AND INJURY TO VEGETATION.

In a recent issue of the "Zeitschrift für Pflanzenkrankheiten," Herr Paul Sorauer described the results of some experiments carried out by him at the request of the Berlin gas authorities, on the injury caused to plants by illuminating gas. The large Berlin parks were utilized for the conduct of the experiments; and they proved well adapted for the purpose. It was proposed, first, to ascertain the nature of the toxic effects due to illuminating gas; and systematic experiments were carefully conducted with many ornamental plants.

Formerly, the blue colouring of the roots was regarded as a satisfactory indication of gas poisoning; but the recent experiments demonstrate that this phenomenon often gives a misleading result. It was observed that in all plants suffering from gas poisoning the chlorophyll was attacked in the first place, and gradually disappeared. In soil permeated with illuminating gas the process of assimilation and the formation of new organic substances are impeded; and the plant utilizes its own substance for intramolecular respiration. These phenomena point to a condition of asphyxia through lack of oxygen in the roots; and if coal gas acts effectively on the roots, the consequence of intramolecular respiration also appears in the portions of the plant above ground. This is the reason why the first parts of the leaf to show discoloration or the disappearance of the chlorophyll, and also the first signs of withering (the appearance of dry spots and edgings), are the edges, which receive the least sap.

As a consequence of the drying of the periphery of the green organs, and the reduced evaporation, an excess of water is soon observed in the lower parts of the stalk and roots of the plant. These often result in wet rot and death of the base of the stalk. This is the case of what is termed "Lohkrankheit," caused by too large a supply of water through the roots. In some large-leaved plants, the appearance of rapidly spreading transparent spots is a characteristic of gas poisoning. In an atmosphere charged with coal gas, transpiration falls off greatly for each gram of fresh substance. If at the time of the reduction of evaporation the plants have an abundance of water, a great accumulation of it takes place in the organs of transpiration, under the influence of which in rapidly-growing plants the cells of the separation layer gradually become less coherent—resulting in the fall of the leaf. In certain classes of trees, big lenticular swellings were observed on the roots, in consequence of an over-abundant water supply.

Association of British Chemical Manufacturers.

There has been registered at Somerset House, as a company limited by guarantee, and not having a capital divided into shares, the Association of British Chemical Manufacturers, with an unlimited number of members each liable for not more than £25 in the event of winding-up. The objects are: To promote co-operation between British subjects engaged as manufacturers in the chemical or closely allied industries; to place before Government and Government officials and others, either in the British Dominions or elsewhere, the views of members of the Association and others upon matters affecting the chemical industries; to develop technical organization; and to promote industrial research, industrial efficiency, and the advancement of applied industry, &c. The management is vested in a Council consisting of not less than sixteen or more than twenty, the first members of which include Mr. Charles Carpenter, D.Sc., Mr. N. N. Holden, and the Right Hon. Sir Alfred M. Mond. The idea is that there shall be "Group" Committees, each consisting of not less than three members. One of these will deal with the distillation of coal, shale, oils, and wood, alcohol, acetone, coal tar, primary products (including ammonia and ammonia products), charcoal, and fuel.

COMBUSTION METHODS FOR USE IN THE LABORATORY.

By J. HEWETT, of the South Metropolitan Gas Company.

[A Paper read before the London and Southern District Junior Gas Association, Jan. 5]

Combustion is not an unknown term in the gas world; but I wish to deal with it to-night on quite a small scale, and more from a practical chemical standpoint than any other. I have, during my association with various phases of the gas industry, been often struck by the somewhat lengthy operations sometimes employed in the laboratory to bring about the fusion, solution, or combustion of certain substances, when it has been necessary to subject them to partial analysis.

As long ago as the year 1907, I was engaged on some experimental work, in which it was necessary to ascertain the sulphur content of certain combustible liquids; and, after trying Carius' method, and meeting with varying success—sometimes being obliged to wait several hours, only to find that the sealed tube had exploded meanwhile—I set to work to devise another way out of the difficulty. The result of my efforts was the apparatus shown in fig. 1.

I evaporated the volatile liquid from the flask by drawing air through it, and then caused the mixture to pass through the tube of silica heated to redness at two points to ensure proper combustion—the products passing through a solution of pure sodium hydrate contained in the wash-bottles. A little bromine or hydrogen peroxide was added to facilitate oxidation. The double T-piece provided means for regulating the evaporation of the liquid, and for ensuring the presence of air in excess; while the screw-clamp allowed the passage of both primary and secondary air to be adjusted. Pure oxygen might have been employed; but as it was not available, I found air quite effective. The method proved to be very useful; considerable quantities of readily volatile liquids containing a very small proportion of sulphur being dealt with. But it presents difficulties when treating heavy oils, and cannot very well be used successfully for solids. I have employed it for a good many estimations of sulphur in benzol and other like liquids which evaporate easily.

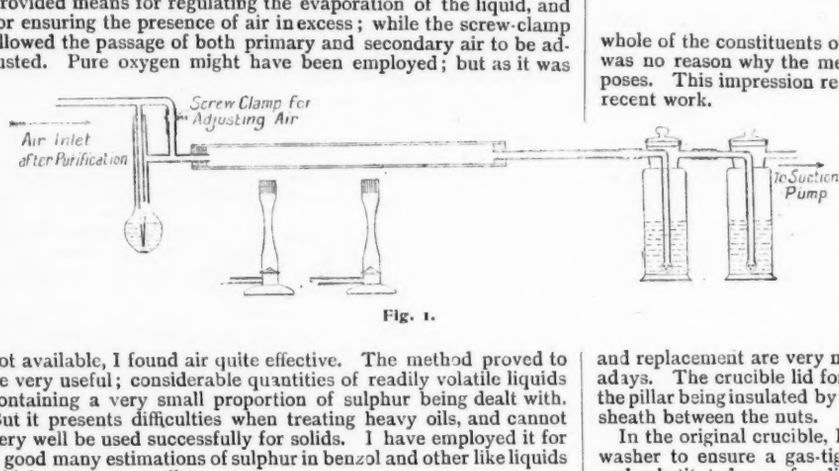


Fig. 1.

The introduction of a flask made of pure silica enabled me to evaporate more heavy liquids; but they have a tendency to distil and adhere to the outlet tube of the flask, and so to be not quite completely evaporated, though the flask can, of course, be heated to redness at the end of the operation in order to carry off the residue. Where the quantity of sulphur is very small and the liquid easily evaporated, this method is very effective and useful, as quantities of the liquid can be treated successively, and the products collected and added together. I have also employed it for the estimation of sulphur in coal gas. By its aid quantities of gas may be dealt with in a short time; and it avoids the effects of outside influences, such as contaminated air.

Below are a few of the many results obtained by this method.

Material.	Quantity Taken.	Sulphur.	Material.	Quantity Taken.	Sulphur.
No.	Grammes.	Per Cent.	No.	C.C.	Grammes per 100 c.c.
1	2·621	1·363			
1	3·177	1·375	8	20	0·1773
2	2·692	1·114	9	20	0·0412
2	2·789	1·117	10	50	0·0261
3	2·750	0·736	11	25	0·0692
4	2·542	1·644	11	25	0·0682
			12	25	0·9808
	C.C.	Grammes per 100 c.c.	13	25	4·5390
			13	25	4·7730
5	20	0·1850	13	25	4·6840
6	20	0·0337	13	25	4·8120
7	20	0·1026	14	25	3·8790
8	20	0·1829	14	25	3·7270

The method to which I wish to draw your attention more especially this evening, however, is represented by the small crucible shown in fig. 2. Recently it has again been one of my duties to conduct experiments where a knowledge of the sulphur content of certain combustible liquids played an important part; and consequently I wished to obtain as many results as I could, in as short a time as possible.

When first using the Roland Wild fuel calorimeter some years ago, I was impressed by the simplicity of the whole arrangement. In this instrument, the finely-powdered fuel is mixed with sodium peroxide, and fired in a sealed vessel under water, and the heat value thereby obtained. The whole operation is conducted in a few minutes; and the results are very consistent. The idea struck me that, as the mixture was fired in a gas-tight vessel, the whole of the constituents of the fuel were retained, and that there was no reason why the method could not be used for other purposes. This impression re-occurred to me on the occasion of my recent work.

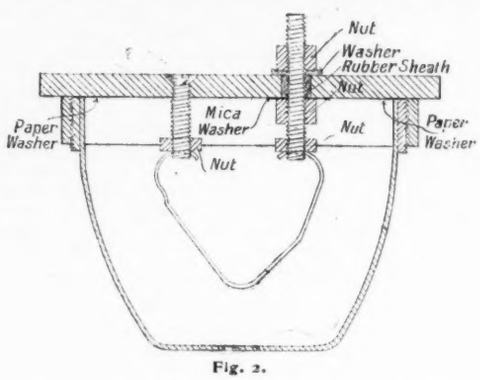


Fig. 2.

In order to try the idea, the crucible was made up in our engineers' shop. The body is of nickel, to which the thread is firmly soldered. The lid is turned to a loose fit, so as to allow of easy removal—the tightness of the joint depending upon the smooth surfaces and the paper washer. I have purposely avoided the introduction of anything weak or intricate in the construction, as simplicity and ease of cleaning and replacement are very necessary advantages in anything nowadays. The crucible lid forms one pole, and the pillar the other; the pillar being insulated by the mica washer and the small rubber sheath between the nuts.

In the original crucible, I at first adopted the use of a rubber washer to ensure a gas-tight joint. But I soon discarded this, and substituted one of ordinary filter-paper, which acts quite as well, and is easily provided. It is also more reliable from a chemical standpoint; the risk of contamination being entirely absent. I did away with the rubber washer on account of the variation in results which I obtained during several experiments with the same liquid. I noticed that the washer was sometimes slightly acted upon, and then estimated the sulphur in the rubber washer, using one of filter-paper in its place. The first experiment was quite successful, and gave a result equal to 7·12 per cent. sulphur.

The following table shows some results obtained, with the weights of material taken, &c.:

Material.	Weight taken.	Sulphur. Per Cent.	Material.	Weight taken.	Sulphur. Per Cent.
No.	Grammes.	Liquid.	No.	Grammes.	Solid.
1	0·983	4·010	8	0·700	7·120
1	0·972	4·080	9	1·000	3·910
2	1·002	8·100	10	1·000	46·880
2	1·022	8·036	10	1·000	47·120
3	0·921	9·334	11	1·000	42·410
3	0·964	9·459	11	1·000	42·830
4	0·690	3·680	12	1·000	41·350
4	0·755	3·890	12	1·000	41·650
5	0·810	0·150	13	1·000	47·620
5	0·600	0·183	13	1·000	47·790
6	0·761	2·328	14	1·000	39·000
6	0·750	2·360	14	1·000	38·410
7	1·000	Nil			

A little practice will enable an operator to judge the best proportions to use, according to the material under examination. In the case of combustible liquids, it is best to take 20 grammes of sodium peroxide to something less than 1 gramme of liquid. The sodium peroxide should be weighed out separately, and before weighing the substance. The material is then carefully weighed, preferably by first balancing the crucible and then adding the liquid from a small dropping tube. The sodium peroxide is added, and the whole quickly and thoroughly mixed using for this purpose (say) a piece of bent nickel wire.

After tightly closing the crucible, the mixture is fired by passing a current from a suitable accumulator, and, if necessary, the crucible prevented from becoming red hot by immersion in distilled

water. The crucible is then opened, and the contents thoroughly washed into a beaker, or, better still, the crucible itself is immersed. Rapid solution of the fused mass takes place. The crucible is then washed, as is also the lid, and the washings added to the contents of the beaker. The subsequent treatment depends on the results required. If for sulphur only, hydrochloric acid is added, and the liquid filtered when acid, then boiled and precipitated with barium chloride in the usual manner. If several constituents are to be estimated, the *modus operandi* must be that required to suit the case. Where only very small quantities of sulphur are present, the precipitation must be carried out with care, and be allowed a considerable time to form and granulate. Two to three hours' boiling is not too long in some instances.

Sulphur is not the only thing which can be estimated quickly by this instrument; its use being only limited, as far as I can see, to the ability to bring about the combustion with sodium peroxide, which ability, if not possessed by the material, may be caused by the addition of fine wood dust or (say) alcohol. The fused mass provides the nucleus, from which the desired constituent may be separated by suitable methods. I use it habitually for the estimation of iron and alumina in new and spent oxide of iron. The fibrous material present enables the combustion to take place perfectly, and avoids the lengthy digestion in *aqua regia*, or like acids, sometimes adopted. The fusion is effected in some seconds; and in a very few minutes the mass is in the beaker. The alumina is separated from the iron during the combustion, and may be removed by filtering before adding acid.

Practically any material can be experimented with, and, if not combustible in itself, may be caused to fuse by the addition of a proportion of combustible matter to the mixture. A few substances might be mentioned, such as: Liquids: Paraffin, benzol, turpentine, naphtha, tar, engine oils, greases, &c. Solids: Coal, coke, rubber, pitch, new and spent oxide of iron. In fact, the list is almost unlimited.

The use of sodium peroxide is cheap, clean, odourless, rapid, and certain. Working in small rooms near offices, the employment of such chemicals as bromine, *aqua regia*, &c., is, in the absence of an efficient fume-cupboard, likely to cause inconvenience; and for those so situated I can recommend this method. A blank experiment with sodium peroxide can always be performed; but I have not up to the present found any cause to complain of this reagent. I have examined it on several occasions.

Rapidity of work and the saving of time have become so very important during the past months, and are likely to be increasingly so in the future, owing to the depletion of staffs necessitated by the needs of the Imperial Forces, that I thought it might be of some value to those engaged on work of this nature to be acquainted with these experiences. It is not assumed by the author that this method is infallible; but its adaptions are so numerous that, with a little ingenuity, it may be made to accomplish many operations in a short time, which have hitherto been much more extended. For instance, taking the estimation of sulphur in coal or coke. Instead of the delay while the oxidation is gradually accomplished, as in some methods, the combustion is all over in a few seconds, and may be repeated on further quantities in a similarly rapid manner, with the further advantage that the operation takes place in a sealed vessel, thereby avoiding any risk of loss.

PRECAUTIONS TO BE ADOPTED.

1.—The weight of the material taken for experiment should, in the case of those very rich in hydrocarbons, not exceed 1 gramme. Then 20 grammes of sodium peroxide are sufficient to produce a melt which is easily dealt with. It will be seen that the size of the crucible limits the quantity of material to be used. The reaction which takes place is very violent with these rich substances, and therefore is likely to cause trouble, if too great a weight is taken.

2.—The material should be as free from moisture as possible, as the presence of water in the mixture is apt to cause premature ignition.

3.—The sodium peroxide should be weighed out first, and separately, so that, when dealing with volatile liquids, it may be added without loss of time.

DISCUSSION.

The PRESIDENT (Mr. S. B. Chandler, of the South Suburban Gas Company) said it was a great pleasure to have this paper from their immediate Past-President. The apparatus which he had described, and which was on the table before them, was originally designed by Mr. Hewett in the laboratories of the South Metropolitan Gas Company, and had been used for some years past by him.

Mr. J. G. CLARK (Gas Light and Coke Company), referring to the end of the silica tube, asked how the connection between the flask and the tube was made.

Mr. HEWETT replied that an ordinary perforated cork was used at both ends. The cork was never burned. He placed it right in the silica tube, allowing a space of about one-sixteenth of an inch at the outer end, and rendered the connection perfectly tight by making a joint of asbestos powder and sodium silicate. This mixture could not be bettered for the purpose. The hotter it got, the tighter it became; and once it was hard, it remained hard. The one-sixteenth inch of space to which he had alluded allowed the cement to enter the tube; while the presence of the cork prevented it from coming in contact with the products of combustion. The cement was quite easily removed from the tube. With a cork alone, it was seldom possible to get a tight joint. Of course, if preferred, the silica tube could be run out right to the wash-bottle, thus doing away with the intervening glass tube shown.

Mr. CLARK emphasized the necessity for making sure that all chemicals employed for such operations were pure. He said he had it in mind to take, when opportunity offered, systematic daily records of the sulphur in the air; and this was something like the method he had in view—to pass it through a combustion tube. Could the author say what quantity his apparatus would deal with, in order to ensure complete combustion of the sulphur?

Mr. HEWETT replied that it was really limited only by the area of the tube that was heated and the absorptive power of the material. When experimenting with coal gas, he thought he passed through from 3 to 5 c.ft. an hour.

Mr. W. L. WESTBROOK (North Middlesex Gas Company) remarked that the cooling effect of the incoming air would have some bearing upon the matter; but, of course, the heated area could be increased by adding more bunsen burners.

The PRESIDENT said Mr. Hewett had given them ample proof of his ingenuity. The apparatus seemed simple, inexpensive, and easy to operate.

Mr. CLARK, in proposing a hearty vote of thanks to the author, reminded those present that the reason they could meet there as they were doing was because of the huge Army in France, among which were a lot of the Association's members. Those with the forces would be only too pleased to feel they were making it possible for their fellows at home to utilize their time in this way.

Mr. E. G. STEWART (Gas Light and Coke Company), who seconded, remarked that anyone doing combustion experiments ought to be well informed on one point—the necessity for not dealing with too large quantities. An apparatus like that before them—fig. 2—was a bomb, after all; and care should be exercised in what was done with it.

Mr. HEWETT, in reply, referred to the time it was sometimes necessary to devote to tests. He recalled that on one occasion he had to estimate the amount of carbonic acid in a sample of gas liquor; and it took him about seven weeks before he was absolutely satisfied that the result obtained was really what it should be.

COKE-OVEN MANAGERS' ASSOCIATION.

Two Recent Discussions.

Discussions which have taken place at two recent meetings of the Midland Section of the Coke-Oven Managers' Association are reported below. The first has reference to a paper read by Mr. J. A. Wilson towards the end of November. An account of the discussion appeared in the "JOURNAL" along with the paper; but it may be remembered that, in view of inaccuracies of which several of the speakers complained [some of which were indicated in the "Correspondence" columns at the time], we said that "the best thing to be done on this occasion, in order to correct misrepresentation, is to ask the various speakers in the discussion to kindly revise the report of their remarks, and then for us to republish it in an early issue." The speakers having complied with this suggestion, we are now able to give the promised revised report. The second discussion took place in connection with the paper which Prof. L. T. O'Shea, M.Sc., read on Dec. 23.

SOME POINTS IN CONNECTION WITH BENZOL RECOVERY.

[See "Journal" for Nov. 28, p. 447.]

The CHAIRMAN (Mr. George Chrisp), in opening the discussion, remarked that he thought the coke-oven industry could safely claim to be the leading benzol people; and gas engineers would do very well to avail themselves of the coking men's experience a little more, and copy their plant and methods. Mr. Wilson's paper would be hailed with some amount of glee in certain circles, and would be of undoubted value to the gas people, as well as to the coking managers. They had heard a most practical paper from a very practical man.

Mr. J. T. PRICE (Manvers Main) opened the discussion with a question as to the comparative cost of upkeep, and also the efficiency of rotary as against tower scrubbers. Mr. Wilson had referred to the packing in his pumps. This was perhaps a very small matter; but he (Mr. Price) knew of some plants where packing for hot oil gave considerable trouble; and he would like to

know what kind of packing was used at Staveley. In regard to the method of testing the benzolized and debenzolized oils, Why had Mr. Wilson hit upon the figure of 165° C.? Why not 160° C. or 170° C.? It seemed to him (Mr. Price) that everyone chose these figures at random; and, as a result, tests could not possibly be comparative. As to his own plant, they at one time distilled up to 130° C.; but he found this far from satisfactory. Now they took the distillation up to 210° C., and then redistilled up to 120° C. Again there was a difference in the apparatus used; and he had found a difference of 12 p.ct. when using a Wurtz flask and an ordinary retort. This all pointed to a need for a proper system of standardized tests. In regard to the oil in circulation, Why did Mr. Wilson work at so high a temperature in his still? His only plea was to keep the water down. But against Mr. Wilson's figures of an inlet temperature of 140° C., and an outlet temperature of 130° C., Mr. Lee, at Grassmoor, obtained better results with temperatures of 108° C. and 105° C. respectively—the water in this case being *nil*. Then, again, with regard to the quality of the oil used—viz., 92 p.ct. at 315° C.—Dr. Colman in his specification declared it should not be more than 90 p.ct. at 300° C. Could Mr. Wilson say what was the objection against oil of more than 90 p.ct. at this temperature? What did Mr. Wilson work his crude benzol up to? If he worked to anything less than 65 p.ct., could he give some estimate as to the amount of increase of toluol?

Mr. WILSON, replying to Mr. Price, said he was afraid he could not deal very well with the question as to comparative costs of scrubbers. The rotary scrubbers had given some trouble at the beginning, chiefly in the engines; but with a suitable smooth running engine, they now found no trouble. They had had trouble at times through the blocking of the outlets by bristles. This occurred more on one plant than the other, owing to the connection from the rotary scrubber to the first tower scrubber in the former case having several bends in it—the bristles when they came loose tending to lodge in these bends and obstruct the flow of the oil. A catch-box had now been placed in the connecting main, to trap the bristles. This was answering well. As to the packing in the glands of the pump, they found cotton packing better than asbestos. With reference to the temperature to which the paraffin distillation test was run, this was fixed the same as for the tests on the benzolized and debenzolized oils; and he had often asked himself the question "Why 165° C.?" They were now experimenting to see if it was really necessary to go so high. With regard to the circulating oil, certain limits had to be fixed as a guide; and in fixing these limits consideration was given, in the case of the fresh oil, to getting an oil which was easily procurable, and which would have at the same time a reasonably long life before rejection was necessary; and in the case of the spent oil, the limit was fixed at a point working beyond which experience had showed led to reduced efficiency. As to the temperature at the inlet and outlet of the still, he had asked that tests should be conducted on this point. At his place, they had always worked at the figures given; and they found if they came down lower the oil was not sufficiently cleared, and if lower still (about 110 to 105), they got water. In regard to the quality of crude oil, at his plant they generally worked at 60 to 65 p.ct.; but in the summer time it went down on its own account. During the past summer, they had been getting up to 60 and 65 p.ct., and had not been recovering in proportion at the intermediate still. This was due to excessive naphthalene caused by the bad condition of one of their batteries of ovens, which they were starting to reline shortly. As to the increase in toluol, the amount of toluol in their total benzol at the present time was very small—only about 9½ p.ct., and that with what was really a low-quality crude; whereas two years ago it was up to 14 p.ct. with, on the whole, a better quality crude—showing that the change must be due to some difference in the nature of the coal.

Mr. G. TAYLOR (Silverwood) said that the author had mentioned having some trouble with bristles from the rotary scrubber. He (Mr. Taylor) thought the bristles were set in the scrubber brushes with pitch, and the solution of the pitch allowed the bristles to fall out; and so caused the trouble. He wondered if any inconvenience were caused by the liberation of gases in the case of the centrifugal pump working on rich oil. Where the benzol absorbed in paraffin was determined by the increase in weight, did Mr. Wilson also determine the dissolved naphthalene, or did he take the total increase as being benzol?

Mr. WILSON said the paraffin was that prepared according to the "British Pharmacopœia."

Mr. TAYLOR (continuing) said the author had also remarked that troubles were caused by variations in the paraffin absorbent. He (Mr. Taylor) thought that if they froze the oil they should get a perfect stripping of the gas sample. In regard to the figures Mr. Wilson gave for the accumulated distillates obtained in his benzol tests, it appeared to him (the speaker) that he got a rather larger amount than he should do; and he thought the amount of distillates in the first case must have been very excessive, seeing that on re-distillation only 38 p.ct. at 120° C. in one case and 9 p.ct. at 120° C. in the other case were obtained. Each plant must find out suitable distillation temperatures for itself, seeing that conditions varied so much in different plants. The relative amounts of benzol, toluol, &c., would keep fairly constant on the same plant; and if trials were made, it was not a difficult matter to find the temperature at which their distillate gave about 65 p.ct. at 120° C. He thought that Mr Wilson should have his wash-oil thinner, because if it became too thick it would cause glutting in the scrubbers. He noticed that Mr. Wilson was very much in favour of the cap-still for rectification. Did he not think that this point was very much a matter of design? They might happen to have a good cap-still and a poor plate-still.

Mr. WILSON said the tar distillers would probably be better able to judge of the relative merits of cap and perforated plate stills than he was; his own experience of stills for the making of pure products being confined to the cap-still. But from the point of view of easy regulation and smooth working, he could not help thinking the cap-still would be the best. In answer to a further question by Mr. Taylor, he said he had not actually collected oxide of nitrogen as such; but it was undoubtedly there at the outlet.

Mr. J. T. WORTHINGTON (Parkgate) said in regard to the testing of the gas before and after the scrubber, the figures on his plant had been 4 p.ct. before and 2·6 p.ct. after. They found that the difference of 1·4 p.ct. was maintained fairly steadily, and he thought this method might be taken as a means of works determining. He had found when he made 65's oil they got about 160. If they made 62's oil, they obtained 70. He thought that the best figure would be a selling basis on a 160 figure and not on 120. The 120 had been imposed on the industry in times when toluol was low priced. The prices had gone up; and he thought 75 at 160 would be a fair figure to give and take, below and above. If they could regulate the feed of the still, they would find whether the oil was being fed to the still properly by the inlet temperature, everything else being normal. At Parkgate, they had had no trouble in getting free from water at 104 output. The quality of the wash-oil was very important. According to the quality of the wash-oil, so they would get their quality of crude oil. At a plant of which he knew, where they used anthracene oil, they obtained 80's benzol. In regard to the separation of the oil for rectification into two fractions, Mr. Wilson took his first fraction much higher than was done at his (Mr. Worthington's) plant. It paid at Parkgate, from the washing standpoint, to change over with slight toluol and wash the heavier toluene. In regard to the investigations which were taking place, he thought the Association ought to apply for a grant for research purposes.

Mr. WILSON said he agreed with Mr. Worthington that 160 would be a better selling basis than 120. At Staveley, they did not sell the crude oil, but worked it up into the final products. If he were working to sell the oil, he would like to sell at anything from 55 to 60. Their test was coming out higher just now; but they found the gain was not due to the benzol, but, as he had already stated, to a marked increase in the quantity of naphthalene. With regard to Mr. Worthington's remarks as to the distillation of the crude oil before washing, the difference between the Parkgate and the Staveley practice was more apparent than real, as there was very little toluol present in the Staveley first fraction. There was a great deal of naphthalene in the oil. Referring to meters, he said that with him the chief trouble had been the corrosion of the working parts, which were of brass and were affected by the ammonia salts. If it were possible to make these parts of cast iron, it would be better from this point of view.

Mr. WORTHINGTON, supplementing his former comments, remarked upon Mr. Wilson's obvious fondness for rotary centrifugal pumps, and said his own experience had been much against them.

Mr. WILSON said it might be, of course, a question of faulty design of the pump or lack of the necessary speed.

Mr. F. C. BISHOP (Blackwell) said a question had been asked by Mr. Price in reference to a suitable packing for creosote oil. He (Mr. Bishop) might refer him to Messrs. G. Angus & Co., who had made a packing to a sample submitted to them at the outbreak of war. The principal thing needed was a standard test both before and after the scrubbers, as he did not think it was so much the working of the still as that which was left in the gas after scrubbing. He knew of only one coke-oven building firm who gave a guarantee of 90 p.ct. efficiency on the white petroleum test, which in his (the speaker's) opinion was the most searching test, and a standard test on the Continent. As for a washing oil, he found a Scotch shale oil better than a creosote, as he had seen 5 to 10 grams more per cubic metre got out with it; and he did not believe with creosote as a washing medium, that there were more than 5 p.ct. of benzol plants getting more than 75 p.ct. efficiency under ordinary working conditions.

Mr. W. GREEN (Manvers Main) said, as to the water trouble, it appeared to him on first sight to be a purely thermal matter; but was this actually the case? The question arose, How did the water exist? Was it free water or water of combination with phenol bodies? The phenols were capable of forming combinations with water; and if the water existed in this state, it would be necessary to raise the temperature of the oil to a much higher one than that of Mr. Wilson's normal working—viz., 140° C. The temperature to which it would be necessary to raise the oil in order to remove the water would be something like 170° to 210° C., as between these temperatures the decomposition of the phenol bodies and water took place; and consequently the water would be removed. This appeared to him to offer a solution of Mr. Wilson's peculiar results as regards the 7 p.ct. of water present in the oil specified. This raised the question of phenols in wash-oils. At a meeting of the Southern District Association of Gas Engineers and Managers reported in the "JOURNAL" for Nov. 21, the President (Mr. W. Doig Gibb) said: "As regards the acids, Mr. John Bond's experiments (not yet completed) seem to indicate that they are probably better left in the wash-oil." But some of the coke-oven

managers might have something to say on their experiences of this question. In connection with "benzol recovery," there seemed in many cases an increase in the phenol content of the wash-oil; and this point he (Mr. Green) thought raised a question as to whether phenols were picked up in the scrubbers. It certainly seemed as though this was the case. He would like to ask Mr. Wilson if it would pay to recover the phenols and bases in the crude benzol. Then came the question as to whether the phenols had any influence on the naphthalene. Naphthalene was said to be a deterrent to wash-oil. It appeared from his (Mr. Green's) own experience that the phenols had a solvent action on the naphthalene, and had the power to carry it in solution. Such points as these were important to the industry, and were very suitable subjects for investigation; and he thought the best the Association could do would be to have a Special Committee to investigate such problems. Then coming to Mr. Wilson's tests on benzol in rich and crude oil, he (Mr. Green) found, as Mr. Wilson did, that, as the water content increased, they got more distillate over at the predetermined temperature to which the oil was distilled.

Mr. WILSON said with regard to the phenols in the wash-oil, they had not gone into the matter, though he thought the quantity would be very small in their case. Speaking generally as to the quality of the wash-oil, his plant's experience had been that, when working at low gas temperatures, they could get good results with a very poor oil. With high gas temperatures, they found they had to be more particular as to the quality of the wash-oil. One of the chief drawbacks to working with a poor oil was the deposits they got in the scrubbers and elsewhere under such conditions. As to the phenols in the crude benzol and the spent oil, they at Staveley had not taken this up so far. As to the loss of benzol in the return gas, he had quoted no figures, simply because he did not think they were worth much on the present tests.

Mr. JAMES W. LEE (Grassmoor) said metering was one of the points which had always been very much to the front in gas engineering. He ventured to ask members present that evening if they know by meter how much water they were supplying to their ammonia scrubbers. This was a point which had occurred much in the gas industry. He entirely agreed with Mr. Wilson that every point of difficulty which they could eliminate when they were out for the tracing of toluol they should take full advantage of. The discussions which used to take place ten or fifteen years ago in connection with naphthalene in the gas distribution industry had had the net result of enabling them to find the curious fact that, where all other conditions seemed to be absolutely identical, that which was trouble in one case was not so in another, and that which was a remedy in one case was not in another. All they could do in papers like that by Mr. Wilson, and those by other members, was to hear the general experiences; but they must not think they could necessarily apply another man's temperatures to their own plant. As to the matter of why the temperature of 165° had been chosen, he thought, in view of all the circumstances of the industry, that this was a fairly natural figure to take; and in his own case they had got into the habit of testing crude oil at 167°. In regard to washing, Mr. Wilson had put the figure at 3½ per cent. He (Mr. Lee) was in the habit of measuring by weight; and he worked Mr. Wilson's figure out at about 7·8 per cent. by weight. This compared with his own figure of 3 per cent. by weight—a very different percentage. He often wondered whether some of the high percentages of benzol recovered here might not be due to the high temperature which Mr. Wilson had. Mr. Bishop had mentioned shale oil as against creosote oil; but he (Mr. Lee) had to suggest again that one man's medicine was another man's poison. Shale oil had increased his own water content very greatly. He had found it absolutely impossible under any temperature to remove the water content, and he had had to change-over once again to creosote. The question arose, Was naphthalene entirely a disadvantage in creosote oil from a washing point of view? It seemed to him it was a very good medium for removing benzol. The trouble, of course, came in the after-treatment, when they had to bring it out. From a mere scrubbing point of view, he held that naphthalene was a clear advantage.

Mr. WILSON said as to the metering he was glad Mr. Lee agreed with his own views. As to the amount of fresh oil circulated, at his plant they circulated up to 100 or 120 gallons per ton of coal carbonized per day. The loss of creosote was rather high; but he was not satisfied with figures he had got out recently. As to the effect of the temperature on washing expenditure, he knew Mr. Lee worked at a lower temperature than they did at Staveley; and it was quite possible that this had something to do with their greater consumption of acid. On their plant, they first of all washed the light oil in the preparation of standard benzol, and then washed the standard benzol for "pure;" and it was to this second washing that his figures for acid referred.

Mr. B. W. HAIGH (Barnsley) said with regard to the percentage of finished products—viz., standard benzol, commercial toluol, and naphthas—recovered from 65 p.ct. crude, he would like to hear from some of those who had had recent experience what figure one might expect. He had heard 78 p.ct. quoted, and even 82 p.ct., though he had been told by others that 72 p.ct. was a maximum.

Mr. WILSON: We find 70 to 72 p.ct. is about our figure—with true 65's rather over 72 p.ct. In this case we get 85 p.ct. distillate from the crude on the intermediate still; whereas now we are only getting 75 to 80 p.ct.

Mr. J. THORP (Barugh, Barnsley) agreed with Mr. Lee that they could profit in several ways from the experience of gas engineers. He said that about 25 years ago a private company purchased gas from the Manchester Gas-Works for the sole purpose of extracting its benzol content; and they used as the absorbent heavy oil from which the anthracene had been removed by cooling and filtration. He felt that to-day this oil had a greater affinity for benzol vapour than any other oil; but in practice, where sometimes the temperature of the gas was high, or there were inefficient tar extractors, the oil became too thick, and unless frequently renewed trouble resulted with the belt-driven pumps supplying the tower scrubbers. And, further, it allowed pitch (from the tar absorbed) to "carbonize" in the oil-heaters. He considered that the best oil was that which had a high boiling point and a low viscosity; and this he obtained by mixing Scotch oil, or blast-furnace oil, with heavy oil. As regards tar reaching the benzol scrubbers, a remedy suggested itself, of having a small preliminary scrubber, with oil in constant circulation until the oil was saturated with tar. At works where they were troubled with water in the oil, he suggested that they should see that their heaters were right, and that there were no leakages in their coolers; then make a complete change of their oil, and maintain this at a temperature of about 2° C. higher than that of the gas.

Mr. WILSON said, with regard to the relative temperatures of the wash-oil and gases, he agreed that there ought not to be a great deal of difference. As to the thickening of the oil, he thought it was a good suggestion that they should wash with oil in a preliminary washer to remove tar fog. In this connection, he thought that Mr. Lee was probably right about the naphthalene question.

Mr. J. P. CARR (Waleswood) mentioned that with the direct recovery plant one was not, in the ordinary course of things, troubled by the oil thickening.

The CHAIRMAN, in bringing the discussion to a close, said he would like to state at once that nobody appreciated more than he did the great work which the gas industry had done in these matters, although he had not been aware that gas engineers were actually the pioneers of benzol recovery. If they were such pioneers, he thought they had hardly got as much experience out of it as they might have done. But, of course, they had been handicapped; and he was sure the coke-oven industry would be glad to give gas men any help possible.

ORGANIZATION OF THE COKING INDUSTRY.

[See *ante*, p. 20.]

The CHAIRMAN (Mr. George Chrisp), in inviting discussion, said that there were many points in the paper by Prof. O'Shea which coke-oven managers, as practical men, often had occasion to talk over.

Mr. J. W. LEE said, as one who had had the privilege of close association with Prof. O'Shea for a number of years, it was a particular pleasure to move the heartiest thanks of the meeting to him for his paper. It might be of interest to many members to know that, only a week ago, at a meeting of the Council of the Association, some of the matters which the Professor had raised had been under discussion, and a small Sub-Committee had been appointed, who would put upon some basis of organization the technical training of the men of the industry. They had all recognized, for some time, that not so long ago the coking of coal was little more than a mechanical process, demanding not much beyond ordinary common sense and the rough handling of men. This was not so to-day; and to some extent development had been rather fast—had been, perhaps, rather faster than the opportunities of education which had been put before some of the men in the industry. But they were all keenly anxious that, while recognizing their own limitations, those who were to follow should have every opportunity given to them to efficiently train for the industry, which was, in the next few years, going to develop even faster than during the past ten years. It was for this reason that the Association welcomed Prof. O'Shea's remarks, and the knowledge that the Sheffield University were always in the forefront in the matters of which he had spoken. The Professor and those who were associated with him really meant what was said. The scheme outlined was an excellent one. But one little factor had been ommited—the management of men. This problem was a very real one; and, if only it could be dealt with, Prof. O'Shea's scheme would be a pertect one.

Mr. B. WILSON HAIGH, in seconding, said there had been absolutely nothing with which he could disagree. The author had put before them an ideal picture of a coke-oven manager; and he was only afraid there were few of them at present who had passed all the stages of training which it was so desirable managers should pass through. In his own experience, he had often felt the need of some of the things that had been mentioned.

Mr. C. P. FINN, supporting the motion, remarked that Mr. Lee had raised an important point on the question of works management. The question of tact in dealing with and handling men was rather a difficult one, and one which his own old chief, who now occupied a distinguished academic position—he referred to Prof. Cobb, of Leeds University—was always keen to impress upon him to have great tact in listening to experiences or suggestions of the men sympathetically. In regard to the selection of men whom they were to have working a plant, very often a youth

who was going in for an academic training went to a secondary school, had a liking for science, and would probably matriculate, and obtain a scholarship which carried him to a place like the Sheffield University, but had no idea as to what particular branch of chemistry he was going to enter. This was the great pity. Sometimes he finally became a teacher in a secondary school. He had known cases of men who were really brilliant, who should have been research chemists, and who had merely become just science teachers in a small provincial school. There was not sufficient encouragement, to his mind, by those people who were themselves acquainted with the technical side of chemistry. As a youth, his own aim had been definitely to be a technical chemist; and he had taken every opportunity in spare time to get into works. He had, however, met with many refusals and rebuffs on the part of some people who, he thought, should have known better. Personally, he was glad to show any boy who was interested in chemistry round his plant, and explain it to him. He thought a good deal could be done if a works management were in touch with the science teacher of the local secondary school. The manager thereby got to know likely material, and might encourage youths to come and look round the plant, or to go and work there during their school holidays. By these means, youths would be encouraged to embark on a definite career, which would be taking the first step towards them getting better trained men in the future.

Mr. W. GREEN said there was a great deal in what Mr. Finn had stated in reference to training. Most of his (Mr. Green's) later training had been under Prof. O'Shea; and he could safely say that, in his humble opinion, a better tutor could not be found for a student who had ideas of his own and wished to put them into practice. The Association could not do better than encourage the authorities of the Sheffield University to do all they could under such a man as Prof. O'Shea. He (Mr. Green) had recently seen in the Technical Press references which showed to what a marvellous extent the coking and bye-product industry was attracting notice to-day. Many of the most eminent scientists of the nation and of allied countries were drawing attention to the importance of the industry, and seeking for better scientific recognition and training of coking chemists and managers. Scientific control was absolutely necessary. The coke-oven chemists were suffering to-day from a lack of proper emolument and equipment, owing to deficient recognition of their importance by those who had the power to supply these things. Little was really known in the coking industry of the chemical reactions which were going on in the carbonization of coal; and things like this would never be rectified until more scientific control was introduced into the plants. In some cases, the trouble was due to the firm or the manager; but it must be admitted that there were doubtless instances in which the blame rested with the chemist. He was very pleased to hear the Council were taking some action. In future the responsibility for any shortcomings which might occur would rest entirely with the Coke-Oven Managers' Association, if they did not pursue this matter properly. They should do everything in their power to further the education and scientific training of the proper men for the industry.

Mr. W. NEWTON DREW (Newton, Chambers, & Co.) said a very great reason why co-operation between the coke-oven industry and the Association and the Universities was of such importance, was the fact that each coke-oven unit was comparatively small. In the case of a great chemical works, they had a vast collection of factories, working on similar things, perhaps, but supporting a big staff of skilled chemists; and it naturally followed that problems which arose in such works could be treated more comprehensively than could be hoped by any of those on the small coke-oven works and laboratories. He could not claim to be connected with the most modern or the biggest coking plant; but he thought he could claim to be connected with one of the most antique. The old original plant at Rockingham would have amused those present. The sulphate plant was really grotesque—most of them had probably never seen anything like it in their lives. The quantities worked were very small; the total carbonization being only about 20,000 tons per year. But it was in the palmy days of benzol; and the balance-sheets showed an annual profit of about £30,000. It was interesting now to see a modern bye-product plant, with its elaborations, grafted on to the old plant. It was, perhaps, rather hard on the men to keep adding to the load of qualifications which the ideal manager should have; but he would like to suggest that the manager should know something of the value of the products he was dealing with, and of the materials he was using in construction. He had been hoping they would have some easy method of saying how much benzol there was in spent gas. He noticed various contrivances were brought out, but could not find that they were really used; and he would rather like to know if there was some fairly simple and accurate method of saying whether one was getting 80, 90, or 95 p.ct. benzol.

Mr. HAIGH remarked that it would do no manager any harm to go and regulate his own gases for a little while, or work the benzol or tar still, and see things from the men's side.

The CHAIRMAN said the training of the future manager was a problem which had occupied the Association's attention for some time. They all realized their own limitations. Most of them had been "pitchforked into the profession," without any previous special training. Coke-oven plants were a good deal easier to erect than were managers to be trained. Men had had to be taken who had some slight engineering and chemical knowledge, and might combine the two accomplishments. If a suitable course of education in any university could include chemistry and also a business course, it would be ideal. One of the troubles was that they could not have a coke-oven plant in a university laboratory. However useful a university training might be, it was essential that there should be practical experience on a coke-oven plant. Prof. O'Shea had maintained that the progress of the industry had been somewhat slow. One must admit this to some extent; but they must not forget that they had always been up-against the prejudice of coke users, and it was only now dying away. Its going would probably clear away many difficulties. With regard to sulphur recovery, the old method by iron oxide, up to the present time, seemed to be the only one of commercial value. The amount of superficial area of ground which they had to cover in the recovery of sulphur on a coke-oven plant was very large; and it had occurred to one or two people whom he knew to attempt the recovery of sulphur from coke-oven gas by some means which would occupy less space. Had the war not come on just at the time it did, the industry would, he thought, have heard a good deal more about this system. Probably they would hear more of it later on.

Prof. O'SHEA, in replying, said he looked forward to the time—and he hoped not far ahead—when some definite scheme of education might arise around the educational centres where bye-product work was going on, so that facilities might be given to all who aspired to have the best advantages of education. Training in the management of men could only be got in the works themselves. A man required special abilities and special sympathies; and unless he had them, he could not manage men. There was no doubt a good deal in what Mr. Finn had said about the need for sympathy and tact as between managers and chemists and men. This only confirmed his own view of the matter of technical education—that it must be conducted with the closest union between the laboratory and the workshop. The career offered to the chemist had never been a great one in England. Every man had to make his own career, and show what he was worth; and as soon as he did this the works were only too glad to take him on. He hoped there was going to be a greater chance for the chemist in the future. The chemist of the future would need to have some training as an engineer—not as a mechanical or a civil engineer, but as a chemical engineer. If the educational authorities would recognize this, they would be able to turn out the right sort of men. As to the question of research, Mr. Drew was quite right. It was very difficult in small works, where the staff was only just sufficient to carry on the work, for research to be undertaken; but it could be done, and done successfully. He had always felt great admiration for the way in which Mr. Drew's firm had tackled what they were now pleased to call low-temperature distillation of coal. How were they in the industry going to bring about these desired effects in the training of the men? They must not act in a hurry. Other institutions older than the Association had undertaken the question of the education of the men who were going to follow-up the industries; and he felt the coke-oven industry would do well to give careful consideration to the experience which they had had. If it was in his power to render assistance to any scheme which the Association might devise, it would give him the greatest possible pleasure to do so, he need hardly say.

Estimation of Sulphur in Coal Gas.

In the "Abstracts" of the Chemical Society is an account of a method described by Mylius and Huttner for estimating the total sulphur in about 200 c.c. of gas, and in about half-an-hour, with the same degree of accuracy as most of the usual methods. The gas is driven at a steady rate from a gas-burette into a small mixing chamber, arranged on the principle of the bunsen burner, into which air is drawn by an aspirator; and the mixture of air and gas (about six times as much air as gas) is led into a small quartz tube, where it meets a roll of thin platinum gauze about 5 mm. long, followed by a roll of platinum fabric, woven of very thin wire, about 15 cm. long. Combustion takes place over a short length of the platinum; the complete oxidation of sulphur dioxide is finished over another short region; while the remaining length serves to trap the sulphuric acid spray, for which purpose the fine metal is very suitable. After all the gas has been burned, the tube is rinsed out and the sulphuric acid is titrated with 0·001 N/sodium carbonate using ethereal idoeosin as indicator. A correction usually has to be made for the alkalinity of the wash-water, the volume of which should be about 20 c.c. It is found that the sulphur content of the gas as drawn from the main varies from hour to hour, according to the temperature. The removal of the carburetting substances, as is being done during the war, has the welcome effect of considerably lowering the amount of sulphur compounds. Experiments have also been conducted on a small scale, in order to find absorbents for the sulphur compounds; and phenylhydrazine is shown to be most efficient. For qualitative purposes, the method of combustion in contact with porous platinum can be applied to 10 c.c. of gas.

At next Tuesday's meeting of the Edinburgh Section of the Society of Chemical Industry, Mr. D. R. Steuart, of Broxburn, will read a paper entitled "The Distillation of Brown Coal in Germany."

MISCELLANEOUS NEWS.

PRESENTATION AT THE READING GAS-WORKS.

In the mess-room at the Reading Gas-Works, on the 21st ult., there was a presentation to Mr. Hamilton Baker, late Assistant Engineer to the Company, on his leaving to take up a partnership in the firm of Messrs. Baker Bros., gas coal contractors, of Reading.

Mr. Douglas H. Helps (the Engineer and Manager), in making the presentation, said they all regretted that Mr. Baker would soon be leaving them. Although it was a pleasing duty to make the presentation, it was much more than tinged with regret at the parting. Mr. Baker had been with the Company no less than 28 years; and during this time they had all learned to esteem and respect him as an upright, just, and fair-dealing man. They would all miss him greatly, and he (Mr. Helps) ventured to say that no one would do so more than himself, and those who had known him longest. For fourteen years they had been associated together as Chief and Assistant; and during all this time nothing had happened to disturb the happy, loyal, and valuable relationship which should exist, and had existed, between the Engineer of such an undertaking as this and his Assistant. He spoke as one who had acted in both capacities They had had some anxious and trying times together; and no one knew better than Mr. Baker all that is entailed in the day's work for one who is responsible for the management of a large gas-works. It did not always end with the day. Mr. L. A. Rumble had been appointed to the vacant position; and he would ask them to give him the loyal support that they had always accorded Mr. Baker. He had great pleasure in handing to Mr. Baker a silver bowl subscribed for by the workmen and staff, and which was inscribed:

> Presented to Mr. Hamilton Baker by the Staff and Workmen of the Reading Gas Company on his leaving, after 28 years' happy association.

At the same time, he would ask Mr. Baker to accept a silver salver from himself, which bore the inscription:

> To H.B., in memory of fourteen years' happy association and help in "The Day's Work," from D.H.H. December, 1916.

The gifts were feelingly acknowledged by Mr. Baker, who said that he had spent nearly thirty years on the works. Many of the old employees he looked upon as old friends, as they would remember him as a boy. They could easily imagine what a wrench it meant to him to leave them; but he felt in duty bound to take up his new appointment. He should like to thank Mr. Helps for the kind way in which he had referred to him. During the past fourteen years, he had acted as Chief Assistant to Mr. Helps. No one could wish for a better chief; and he would like to endorse all Mr. Helps had said with regard to their business relationship. It was, indeed, a pleasure to work under Mr. Helps; and he felt sure he was voicing the feelings of all of them when he said this. When he looked at these beautiful presents, it would bring back to his memory the happy time he had spent at the Reading Gas-Works. Thirty years was a big span in a man's life; and the friendships he had made during this period would always be cherished.

LIGHTING RESTRICTIONS IN BIRMINGHAM.

"After unconscionable delay, the reasons for which it is very difficult to fathom," says the "Birmingham Daily Post," the Judicial Sub-Committee of the Birmingham Watch Committee have framed a report, and made recommendations, on the subjects of street lighting and the release of eligible men from the police force. The report has been adopted by the Watch Committee, "and, presumably, will be presented to the next meeting of the City Council for approval." Our contemporary remarks that, "while it may be granted that the report now framed goes some way towards satisfying the obvious necessities of the case, one cannot help feeling that it has been presented with some reluctance. The recommendations with regard to street lighting are inadequate, and merely touch the fringe of the problem; and those regarding special constables are so presented as to suggest that throughout the Committee have not been actuated by any great anxiety to release young policemen for service in the field."

With the latter subject we are not, of course, here concerned. The question of restricted lighting, the report stated, had for some time past received the unceasing attention of the Chief Constable and of the Sub-Committee, who realized it was one involving very grave responsibility with regard to the safety of the town. The Sub-Committee had always had in view the questions of public safety and public convenience, and had been desirous of providing as much light as possible, compatible with the important duties imposed upon the police authorities by the Lighting Orders. They had had frequent consultations with the Chief Constable upon this subject, and had also been in communication with the military authorities with regard to the existing conditions of street lighting in the city. The latter had recently expressed the definite opinion that there was no unnecessary darkening of the town, and that they could not recommend any appreciable increase of street lighting. The Sub-Committee, acting upon the advice of the Chief Constable, had considered various proposals in detail, with the view of affording where possible further lighting facilities. As a result, the lights on the fronts of the tramcars had been improved, and a large number of overhead lights had been, and were being, placed in connection with the existing overhead tramway electrical equipment. This would afford convenience and safety to tramway passengers, as well as to the general travelling public. Generally speaking, Birmingham was lighted with gas; but in the portion which was electrically lighted, arrangements had been made to light at street-corners a number of lamps shaded-down with blue. These could be simultaneously extinguished in case of alarm.

In the important shopping and business quarters in the centre of the city, it was proposed to light a number of additional lamps (which would be automatically extinguished at 7 p.m.), so as to add to the convenience of persons shopping and carrying on business. Arrangements had also been made to instal at various dangerous points throughout the city lamps with flat-flame burners, shaded with blue glass; and similar lamps were being provided at stopping-places in suitable positions along the various omnibus routes. It was hoped the effect of the foregoing arrangements would be to minimize causes of complaints which had been received by the Sub-Committee.

The report pointed out that the provisions of the Lighting Order required all external lamps to be extinguished, except such lamps as the chief officer of police directed to be kept in use for public safety, and any other lights approved by him. It was added that the more powerful lights now allowed on motor-cars under certain conditions would, it was anticipated, materially reduce the risk of street accidents caused by vehicles. The total number of street accidents in 1913 was 3068, and in 1916 3231.

In moving the adoption of the report, Alderman Sanders said they found from inquiries that Birmingham was as well lighted as other towns. In Nottingham the previous week the streets appeared darker than those in Birmingham. Newcastle, the Hartlepools, and Bradford were much on the same lines; but in Liverpool, in consequence of complaints, the authorities had relaxed their regulations within the last few days. So the position was that Birmingham was quite as well lighted as some towns, and better than others.

The Lord Mayor (Alderman Brooks) remarked that they had to reconcile public safety and the safety of the town with public convenience. If one of two things had to be sacrificed, it must be public convenience rather than public safety. He understood the Committee had been in communication with the military authorities, and that the latter did not think there should be any further relaxation of the restrictions than those recommended in the report. With regard to street accidents, they had come to the conclusion that no undue proportion was due to the lighting restrictions.

GAS-METER TESTING AT MANCHESTER.

An Old Question Revived.

At a Meeting of the Manchester City Justices' Gas-Meter Testing Committee last Friday, under the chairmanship of Colonel H. T. Crook, D.L., M.Inst.C.E., there was a long and spirited discussion upon a report of the Committee with reference to the controversy between the Justices and the Manchester Corporation Gas Committee [see "JOURNAL" for May 2, 1916, pp. 233-234], as to whether the meter-indexes should be tested.

The latest reports of the Gas-Meter Testing Committee—including a notable minority report by Mr. H. N. Barrow—show that the Gas Committee and the Justices are still at loggerheads over the matter. The position taken up by the Justices' Committee is that the abolition of the index system of testing is prejudicial to the interests of the gas consumers, and that the poorer classes of householders especially would suffer from any relaxation in the stringency of testing. The Gas Committee, on the other hand, are desirous, on the ground of economy and uselessness of the test, of having it discontinued. Voluminous correspondence has passed between Alderman Kay, J.P. (the Chairman of the Corporation Gas Committee) and Mr. Frederick A. Price (the Superintendent of the Gas Department) and Colonel Crook, from which it appears that the test has been applied for over fourteen years, and that from the last annual report of the Meter Inspector (Mr. S. Dyson) during this period only some 900 meters had been rejected for index error, or an average of 64 per annum. Last year nearly 40,000 meters were tested.

The recently-issued report of the Justices, however, lays special emphasis on the fact that the Inspector's last report disclosed a meter which had been "lying" for more than twenty years to the extent of 100 per cent. "fast," or recording twice as much gas to be paid for as was consumed. "How many humble homes," the report asks, "may have been defrauded by these cheerful little liars"?

In his minority report, Mr. Barrow (one of the members of the Justices' Committee, who has special technical knowledge of the subject, and is connected with the gas-fittings industry) supports the Gas Committee's contention that the index test is unnecessary and useless. It was evident, he remarks, that the Gas Committee understood the question when they refused to pay the Testing Committee £400 a year for a useless test.

In the course of the discussion, it was suggested that the Gas Committee should again be asked—they were asked last May—to meet the Justices' Committee in conference. This was opposed by Alderman Kay, who said the Gas Committee had made up their minds on the question. In the end, however, further discussion was postponed, with a view to a conference being arranged, if possible.

LOUGHBOROUGH GAS UNDERTAKING.

The effect of war conditions is reflected in the affairs of the Loughborough Corporation Gas Department. In presenting the half-yearly accounts at the last meeting of the Council, the Chairman of the Gas Committee (Mr. F. W. Charles) explained that the balance of profit derived in the period under review amounted to £1423 only, as compared with £2855 in the corresponding period of 1915, representing a depreciation of over 50 p.c. Fortunately the undertaking possessed a small reserve; so that it was still hoped to avoid entailing any burden on the rates.

He confessed, however, that the serious way in which the undertaking had been hit occasioned uneasiness as to the future. One of the primary causes of the decreased profits was the largely enhanced price

of coal, which, in the last half year, meant an additional outlay of £862. To some extent this was compensated for by an extra amount realized upon coke. Receipts from public lighting were also less by £265. In the cost of purifying the figures were lower than in previous periods. Repairs had entailed an outlay of £960, against £517; this being attributed to the laying down of new retorts, which cost £421. Higher cost of labour and material had been met by increased economy in plant. The number of ordinary consumers had risen from 2139 to 2147; slot-meter consumers, from 3570 to 3769; and ordinary cookers, from 737 to 790. The gas consumed through slot-meters amounted to 19,230,900 c.ft., against 20,204,560 c.ft.; the decrease being attributable to the lighting order and the absence of the military from the town. There had been sold altogether 38,061,300 c.ft. of gas, against 43,510,700 c.ft. Water gas was *nil*, against 6,250,000 c.ft. in the corresponding period.

The report was adopted.

The profit in the half year just completed has been £1423 only, against £2855 in the corresponding half of the previous year. The Committee, in the later period under review, have had to encounter a 15½ p.ct. increase of expenditure, and a decrease of 50 p ct. in profit. The interest charges on capital invested amount to £4258, or 3½ p.ct. In connection with the undertaking, £121,975 has been borrowed, to be repaid within 40 years, of which 25 years have already expired, and a further sum to be repaid in 20 years, of which 8 years have elapsed. Against this, there is £33,291 in the sinking fund.

GAS PROFITS AND THE RATES.

The Example of Workington.

The Mayor of Workington (Alderman F. Hall) was for ten years Chairman of the Gas Committee; and the Committee have tendered him their best thanks for the great services he has rendered to the borough in that capacity. In acknowledgment, Alderman Hall said that since he became Mayor he had looked up the records of the department from 1888 onwards. He then quoted statistics which were subsequently printed in the minutes at the request of the Committee.

Taking the periods under four Chairmen, in 1892 the quantity of gas sold and accounted for was 52,186,500 c.ft., and the yield of gas per ton of coal 9295 c.ft. In 1899, the figures were 67,645,200 c.ft. and 8813 c.ft.; in 1906, 93,417,000 c.ft. and 10,332 c.ft.; and in 1916, 122,883,200 c.ft. and 12,910 c.ft. Over the four years 1888 to 1892, nothing was contributed in aid of the rates; in the seven years 1892 to 1899, £8147 was contributed; in the seven years 1899 to 1906, £1950; and in the ten years 1906 to 1916, £8428. Alderman Hall said that during the seven years 1892-9, all the net profits were transferred in aid of the rates; and at the same time the works plant was allowed gradually to deteriorate, until it became absolutely exhausted and unfit for use—the sequel culminating in 1901, when the retorts gave out and only yielded 7734 c.ft. of gas per ton of coal. The year 1901 was the most disastrous in the history of the undertaking. There was a loss of £2613 on the year's working; and, in addition, the reserve fund was exhausted, and an overdraft of £802 created at the bank—entirely due to the policy adopted in the seven years referred to. During his ten years' chairmanship, the Committee had wiped out a debit suspense account of £4000, contributed £8428 directly in aid of the rates, reduced the cost of public lighting by £525 per annum (thus further reducing the rates by this amount), reduced the price of gas, and at the same time remodelled the works, and secured an up-to-date plant equal all-round to an output of a million cubic feet of gas per day. The yield is now over 14,000 c.ft. of gas per ton of coal. From the purchase of the gas-works for a period of nearly thirty years not a penny of the purchase-money was written-off.

WIGAN GAS-WORKS FINANCES.

Some remarks on the financial position of the Wigan gas undertaking were made at the last meeting of the Wigan Borough Council, on the presentation of the Gas Committee's minutes.

Mr. FARR (the Chairman of the Committee) said it would be noticed that, at the request of the Minister of Munitions they were putting down a benzol plant. If they made a success of it, it might be the commencement of a wider scheme which was brought before the Gas Committee two or three years ago. They had handy people about them at the gas-works; and he thought they would be able to rig-up the plant with their own staff. It was also their intention to pay for it out of revenue. The financial arrangements were rather vague; but if they could make a success of it, and afterwards show a profit, they would be very pleased. If it were a loss, it would be another sacrifice at the gas-works in a good cause. There was one point he wished to make clear. If they took benzol out of the gas, it would affect it from an illuminating point of view; so their advice to their 20,000 customers was that wherever possible they should substitute a mantle for a flat-flame burner. There were cases, he supposed, where this was impossible; and when they got the plant working, if those people would apply at the gas-works, they would be prepared to supply them with a special burner which had been invented to be used with debenzolized gas. He would, at the same time, like it to be understood that from a calorific or heating point of view the gas would not be affected. In the minutes, there was a financial statement of the six months' working of the Committee. The statement was nothing to boast about; but, on the other hand, it was not quite so bad as it looked. The amount they had saved on street lighting had been more than absorbed by the increased sum they had had to pay for income-tax. It was alleged that they made a large profit at the gas-works. He had never been able to see very much of it himself; but judging from the way their income-tax assessment went up, he supposed it must be so somewhere. He would like to draw their attention to the huge item of £5820 for rent, rates, and taxes for six months. For the same period in the electric light undertaking, there was the paltry sum of £837. This meant that the Gas Committee were paying £10,000 a year more than the Electricity Department; and while he knew there were reasons why there should be a large difference between the two undertakings, he thought there was a case for some redistribution of the burdens.

Mr. M'CURDY, in seconding, emphasized that the assessments required overhauling. He pointed out that in 1916 they spent £2355 for gas-stoves, as against £926 in 1915. They ordered a great many stoves, and had no reserve fund to fall back upon. They would have had to borrow and create a sinking fund; but owing to the war it was impossible to do this, and what they did was to pay for all out of revenue up to the end of the month of June. Payment for others would be spread over a short term. In any case, it would have been necessary to introduce a new system of payment, because it would surprise many of them to know that there was standing to debit £12,000 for gas-stoves, and there was not a single halfpenny for the repayment of this by the old system of finance. Of course, the stoves were kept in order and repair; but a great many would become obsolete. It was another burden which sooner or later those now in charge of the gas-works would have to liquidate.

COST OF COAL IN THE UNITED STATES.

A Federal States Commission.

In view of the prices that gas undertakings, in common with other users, are called upon to pay for coal, no apology is needed for reference to a paper reviewing the leading items that go to make up that figure, and proposed State regulation of the same, recently read before a meeting of the American Mining Congress by Messrs. G. Otis Smith and C. E. Lesher, of the United States Geological Survey. The items referred to as normally controlling the price to the consumer are resource, mining, transportation, and marketing, each of which includes profit that may appear either excessive or inadequate, according to the point of view. But an unbiassed consideration of each was essential to a fair decision as to whether coal is sold at a reasonable price, and if not, why not.

The resource cost was that which the operator had to pay for coal in the ground, and consisted of royalty or depletion payments to the owners of the land. One of the latest leases issued by a large owner was on the basis of 27 p.ct. on the selling price at the breaker. The average rate of royalty throughout the country on anthracite was 32 c. to 35 c. per ton, representing 12 to 14 p.ct. on the selling price; and the rates varied from 10 to 27 p.ct. They gradually advanced from 8 c. to 10 c. fifty years ago, to the present figure; and the tendency was yet upwards, by reason of increases on intermediate sizes of coal and rates based on a percentage of the selling price. One of the largest owners in the country was realizing 50 c. per ton from his coal lands. The bituminous coal industry was comparatively a modern institution, and much of the land was acquired by the operating companies within the last twenty years for little more than bare surface value. The present average resource costs were not much over 5 c. per ton, or 4 p.ct. on the selling price at the mine.

The mining cost was the value at the outlet from the mine, and included wages, supplies, and power, both below and above ground, together with profits on the sale, and it not only varied in different districts, but also in adjacent mines in the same field. The census of 1909 indicated as the net mining cost an average cost of $1 per ton for bituminous coal and $1·86 for anthracite; but some operators thought that these figures were too low. In a general way, the mining cost included 70 to 75 p.ct. for labour, 16 to 25 p.ct. for material, 2 to 4 p.ct. for office expenses, insurance, &c., taxes 1 to 7 p.ct., selling expenses, nothing to 5 p.ct., and workmen's compensation, which in some cases might reach 5 p.ct. Charges for labour, material, general expenses, and depreciation were easily understood, but taxes and selling expenses may be overlooked by the casual observer. Manufacturing companies who consume their own product, and those who sell direct to railways and other large users, have no selling expenses; but producers for domestic and general use must figure on a selling cost of some 10 c. per ton. The average for bituminous coal is probably 5 c. to 10 c., and for anthracite 10 c. to 15 c. per ton.

Transportation companies and producers are not so much concerned with the actual carrying charges as with the adjustment of rates between different districts and markets. Rate structures have been gradually built-up, giving to this or that district differentials over others that may be based on the length of haul and ability to compete by reason of advantage in respect to mining cost or quality, or for which no special reason exists. But the consumer is interested in the actual rather than the relative freight rate. The average consumption throughout the States is 4·6 tons per head of the population, of which 1 to 1½ tons are for domestic consumption. Transportation cost must of necessity bulk largely in the national fuel bill.

The cost of handling the coal from the time it leaves the mine, exclusive of freightage, until it is delivered into the consumer's fuel bin, is the marketing cost. Much of the coal is sold direct to truck users, and therefore is not subject to this item; but a considerable quantity passes through the hands of wholesale jobbers before it reaches the actual retailer. Coal that gets a long way from the mines may pass through many hands, paying commissions all along the line, and also subject to shrinkage and depreciation, all of which piles-up the selling price to the user. A broker is usually satisfied with a gross profit of 10 c. per ton; but if several in succession take a turn over on the same cargo, this item may be correspondingly increased.

Comparing the respective shares received by capital and labour, the working miners, the railway men, and the wagon drivers together receive fully half the price paid by the consumer. Landowner, bond and share holders in coal and railway companies get about $1·15 per ton for anthracite and only 50 c. to 75 c. for bituminous coal. In either case the mine operator's share is small.

There is little prospect of relief on the current prices of coal. Anyone who is cognizant of the trend of prices of labour and material can

see but slight prospect of lower prices on either. Observation of advances in mining methods affords no warrant for expecting further reduction in operating costs. Something might be done in the way of reducing the average length of haul; and users of coal might with advantage study more economical methods.

Examination of these items emphasizes the lack of special facts that can only be supplied by the use of uniform methods of accounting and cost-keeping, which, if available, would furnish more definite replies to the user's appeal for lower prices. Government operation of mines is not promising; and Government control by the regulation of prices is more in line with the trend of modern public sentiment. Judging by experience in the regulation of other public utilities, the Public Coal Commissioners would be given sufficient discretionary powers to safeguard the interests of producer and consumer alike, and even mandatory requirements would be subject to judicial review. Competition had not benefited the consumer. In the bituminous districts it had proved wasteful, and there was no healthy competition in anthracite. In either case the result was to saddle the industry with charges for idle mines and increase the resource costs. State regulation of prices needed to be under federal control, and should not stop at freights and mining costs, but, as trustees for the people, exercise full rights over coal in the ground. The private owner had no right to decide whether the coal should be mined as needed, or held back with a view of forcing prices. The proposal to bring land owners into line with operators and carriers may appear radical; but coal was the very life on which the industrial society depended.

Public control by Federal State Commissioners would be fair, and in the long run beneficial to all parties concerned, because the control of prices must determine control of costs; and the operators appeared willing to rest their case on a determination of actual costs and the figuring of profits thereon.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Jan.* 8.

It is reported that business has been done in solvent naphtha at 2s. 3d. net per gallon in bulk. Pitch remains steady at 22s. to 22s. 6d. net per ton f.o.b. makers' works, and a somewhat higher price for local trade. The position of creosote is quite firm at 75s. net per ton at makers' works; and there are a good many buyers for home fuel purposes.

Sulphate of ammonia for farmers remains at the official price of £15 10s. net per ton for 24½ p.ct., bags free, *ex* producers' works. For export, makers ask about £18 5s. net per ton for 25 p.ct. quality, filled into buyers' bags at works. The exports of sulphate for last year totalled 259,312 tons, as compared with 294,308 tons in 1915, 313,877 tons in 1914, and 324,704 tons in 1913.

Tar Products in the Provinces.

Jan. 8.

There is no alteration in the markets for tar products. No business of importance is reported in pitch. Solvent and heavy naphthas are steady.

The average values of gas-works products during the past week were: Gas-works coal tar, 19s. 3d. to 23s. 3d. Pitch, East Coast, 16s. to 16s. 6d. per ton; West Coast—Manchester 15s. to 15s. 6d., Liverpool 16s. to 16s. 6d., Clyde 17s. to 18s. Benzol, 90 p.ct. North, 10½d. to 11½d.; 50-90 p.ct., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 3d. Coal tar crude naphtha, in bulk, North, 6¼d. to 6½d. Solvent naphtha, naked, North, 1s. 8d. to 1s. 9d. Heavy naphtha, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, 3¼d. to 3½d. Heavy oils, in bulk, North, 3⅞d. Carbolic acid, 60 p.ct., East and West Coasts, 3s. 4d. naked. Naphthalene salts, 70s. to 80s., bags included. Anthracene, "A" quality, 2¾d. to 3d. per unit; "B" quality, ¾d. to 1d.

Sulphate of Ammonia in the Provinces.

LIVERPOOL, *Jan.* 6.

Throughout the week the market has continued very firm, though business has been rather quiet, in consequence of the limited supplies offered for shipment and the restrictions on exports placed by the Board of Agriculture. At most ports prices are again a little higher, and the quotations to-day for January are £18 15s. per ton f.o.b. Hull, £19 f.o.b. Liverpool, and £19 2s. 6d. f.o.b. Leith. For future delivery, most of the premium has been lost, as prompt values have attained their present level, and it is reported that business has been done over the whole of this year at practically to-day's price for January.

Nitrate of Soda.

The price of this article is again dearer, and the spot quotations are now 20s. per cwt. for ordinary quality and 20s. 6d. per cwt. for refined.

Sulphate of Ammonia.

From another source, to-day's quotations are as follows: Outside London make, £17 7s. 6d.; Hull, £18; Leith, £18 7s. 6d. to £18 10s.; Liverpool, £18 7s. 6d. to £18 10s.; Middlesbrough, £18 5s. to £18s. 7s. 6d.

A Review of the Manchester Tar Products Trade.

In their report on the chemical trade of Manchester during the past year, published towards the close of last month, Messrs. Sir S.W. Royse & Co., Ltd., include the following remarks with reference to tar

The "Fire Queen"

The Latest "Main" Gas Fire.

It is designed to co-ordinate in size with *any* modern Interior Grate.

The fire backs and heights over-all are graded to coincide with the dimensions of Standard Grates. Note the appearance when in use. So like a bright coal fire, and it will pass all the "tests" for Efficiency and Ventilation.

R. & A. MAIN, LIMITED.

WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.
SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 83, Old Market Street, BRISTOL; 18, Severn Street, Deansgate, MANCHESTER; 97, Millfield, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

products and sulphate of ammonia: Benzols, 50-90 p.ct. and 90 p.ct., have remained unchanged throughout the year at 1s. 5d. and 11½d. respectively. The production has greatly increased, and has been fully required. Solvent naphtha varied but little during the first three months, but has since fallen 3d. per gallon, and is steady. The production of creosote has largely increased, and during the first six months the price fell from 2¾d. to 2d. per gallon; but there has since been a largely increased demand for fuel purposes, and the price has advanced to 2¾d. per gallon. Crude carbolic acid was lowered slightly in January, and has since remained unchanged. Crystal carbolic has gone through the year without alteration. Liquid carbolic advanced 3d. per gallon in the first six months, and has since fallen 5d. per gallon to the present firm value of 2s. 5d. Pitch has fluctuated between 12s. 6d. and 20s., and is at present easy at about 14s. 6d. per ton. The home demand was fairly steady; but the export trade has been slow and difficult. Sulphate of ammonia fell from £18 2s. 6d. in January to £17 2s. 6d. in May, and has since advanced to £19. Arrangements made to supply increased quantities for home agriculture and for special purposes leave smaller quantities available for export; and licences to ship are now less freely granted. Exports during the eleven completed months of 1915 and 1916 are respectively 278,520 tons, value £3,733,550, and 235,883 tons, value £3,945,889.

COAL TRADE REPORT.

Northern Coal Trade.

There is more variation in the coal trade of the north-east—partly because of the slower arrivals of steamers, and partly because there is some stoppage of exports to Norway; but in the circumstances the trade is steady on the whole. In steam coals, the prompt demand is full; but for forward it is rather more irregular. Best Northumbrian steams are about 30s. per ton f.o.b., and second-class qualities are from 24s. to 26s. Steam smalls are plentiful, and may be quoted as from about 17s. to 20s. In the gas coal trade, the demand is full, and stocks have been reduced in the holidays. Best Durham gas coals are steady at from 25s. 6d. to 27s. 6d. per ton f.o.b., second-class qualities are 18s. 6d. to 20s., while "Wear Specials" are firm at from 30s. to 32s. 6d. The home consumption of gas coal is now at its height. Exports to France are steady; so that the collieries have activity which will continue for weeks. Very few new contracts are being negotiated; and those that are, chiefly mark "limitation" prices. The increased demand for coking coal has its effect on nearly all classes of Durham fuel. Freights are high to neutral ports. In the coasting freights, gas coal from the Tyne to London is still near 15s. 6d., which is above the average of the past year. Coke is in increased use both at home and for export, and good gas coke is quoted from 33s. to 34s. per ton f.o.b. on the Tyne. Despite the high freights, the export of coke is much above the average of recent years.

Lighting Conditions in the Streets.

Referring to the paper lately read by Mr. Leon Gaster before the Illuminating Engineering Society, in which the author dealt with the question of the lighting conditions of the streets, "Municipal Engineering and Sanitary Record" says that councils and bodies representative of local government work "knew, or should have known, that the conflicting and impracticable orders which emanated from the Home Office were the product of persons who were not conversant with street illumination, and that they were also oblivious of the waste of public money. Their duty assuredly was to request that a Consultative Committee, composed of municipal and gas engineers, and representatives of Councils and such bodies as the Illuminating Engineering Society and the Institutions of Gas and Electrical Engineers, should be appointed to act in conjunction with the Home Office authorities. Consultative Committees have been appointed by other Government Departments for a variety of purposes during the war period; and the co-operation of local authorities has been widely sought by the Local Government Board and the Board of Agriculture. Is it not expedient they should now insist upon the reason why they have been so strangely ignored, and with consequences which have been so disastrous?"

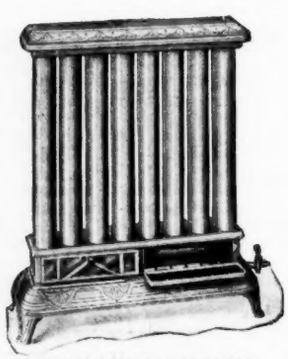
Price of Gas and the Rates at Batley.

Minutes of the Gas Committee approved at last week's meeting of the Batley Town Council recommended that the price of gas should be increased 4d. per 1000 c.ft. from Jan. 1. Alderman Stubley explained that this course was necessary if they were to avoid a deficit at the end of the financial year. The Corporation were paying 50 p.ct. more for coal, and were receiving 50 p.ct. less for some of the residuals than before the war; while the rates and taxes on the gas undertaking had gone up 15 to 17½ p.ct. Owing to the Summer Time Act, the output was much lower; the consumption in six months being decreased to such an extent that if it continued at the same rate, there would be a falling off of 12,000,000 to 15,000,000 c.ft. in the twelve months. Since the war began the gas charges had only been increased 32 p.ct., including the advance now proposed; and he was afraid that there would have to be a further increase after March. Mr. Oldroyd regretted that Alderman Stubley had not given the real reason for the advance, and said it was due to the Corporation having in the last ten years taken £45,000 from the Gas Department for the relief of the rates, when the actual profits were only £41,650. The fact that they had an obsolete plant and no money to pay for a new one showed that there had been mismanagement. It was unfair to ask the gas consumers to make up a deficiency caused by the money they had contributed having been taken for the relief of the rates.

At the last meeting of the Ossett Corporation Gas Committee, the question of the employment of women at the gas-works was discussed, and it was resolved that the Manager be authorized to engage females.

Gas Heating for Camps.

60 "VENETIAN" (WHITE LIGHT) RADIATORS—



VENTILATING RADIATOR.

"Gas Heating for Munition Factories"—see our next Advertisement, dealing with this important subject.

recently supplied to a large Military Camp for heating Huts. Our knowledge and experience of Military requirements are placed at your disposal to co-operate on any enquiry for heating by Gas Steam, Steamless, White Light, or Hot Water Radiators from Central Boiler.

¶ Military and Red Cross Authorities regard the installation of Gas Heating Apparatus with favour and will be glad to respond if suitable equipment is brought to their notice.

THE RICHMOND GAS STOVE & METER CO., Ltd.,
WARRINGTON AND LONDON.

Gas Light and Coke Governor's Greeting.

The "Co-Partners' Magazine" of the Gas Light and Coke Company for this month contains the "Governor's Greeting for the New Year;" and in the course of it, Mr. John Miles says: We have suffered a very great loss in the death of our most energetic and valued Governor, Sir Corbet Woodall, who was the originator of the co-partnership scheme as affecting this Company. He lived to see the effect of a reduction in the amount distributed, and the loyal way in which this reduction was received by all. May we soon see a pleasanter state of affairs, and the horrible conditions of warfare terminate in a conclusive and honourable peace. But this is not yet. Under medical advice, our Secretary, Mr. Rayner, after the long period of forty-two years' service, retired; and we all wish him happiness and contentment for the remainder of his life. Our good friend, Mr. Milne Watson, who has the interest of every class of co-partner at heart, has been elected on the Board, and is now our Managing-Director. No better selection could have been made. In consequence of the war and high prices, our Company is still suffering heavily; and the difficulties with which we were surrounded twelve months ago continue in an aggravated form. All the more reason why each co-partner should not only exercise all his powers in the department in which he works, but also adopt habits of thrift on all possible occasions.

Increased Prices at Nottingham.—Upon the report of the Gas Committee, recommending increases equivalent to about 5 p.ct. for power and gassing purposes [*ante*, p. 34], coming up for adoption at last week's meeting of the Nottingham Corporation, Alderman Ball (the Chairman) said that, as gas for power was costing over 1s. 11d. per 1000 c.ft., *plus* distribution and stamping charges, it was obvious they could not continue to supply it at 1s. 6d., *plus* 12½ p.ct. Mr. E. Richards and Mr. Clarkson, who are both interested in local staple industries, enunciated the view that the charge for power and for gassing should be placed upon the same basis; and the Chairman promised to bring the point before the Committee.

Wages Questions and Conditions at Stockport.—The minutes of the Stockport Gas Committee show that at the last meeting the Engineer (Mr. Meunier) reported that the engine-fitters, blacksmiths, &c., had been awarded 3s per week extra "war wages;" and that an application had been received from the draughtsmen at the works for an increase. It was resolved that the consideration of the application be deferred until their wages were revieved in March. The Engineer also reported advances in wages to workmen by the Manchester Building Trades' Association, and that these advances would be paid to the men concerned who are employed at the gas-works. On the question of shortage of labour, Mr. Meunier reported that the Works, Sub-Committee had further considered the question of twelve-hour shifts, and had authorized him to communicate certain terms to the Municipal Employees' Association. The Committee unanimously approved the terms.

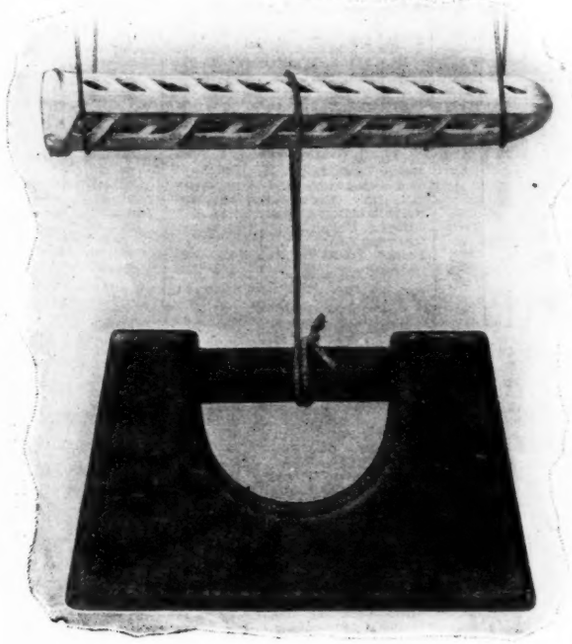
Damage Caused by Burst Gas-Pipes.

The Law Committee of the Association of Municipal Corporations have considered the matter of the bursting of water-mains, in connection with which the Town Clerk of Ealing prepared a memorandum pointing out the facts as affecting local authorities outside the London Metropolitan area who act as surveyors of highways. Precedents, he said, for the recovery of damage done by the bursting of reservoirs, aqueducts, pipes, or other works constructed or maintained for the purposes of any Special Act within the locality where the construction of a reservoir has been authorized, are contained in various Private Acts; and to cover the matter generally he suggested a clause somewhat as follows: "Any person, company, or other body authorized to lay and maintain aqueducts, mains, or pipes for the supply of water, or mains or pipes for the supply of gas, along, over, or under any highway within the area of a local authority in whom the said highway is vested, shall make full compensation to the said authority for all damage and injury, losses, and expenses whatsoever, which the said authority may sustain by reason, or in consequence, of the bursting or giving way of any such aqueduct, main, or pipe." In their report upon this, the Committee recognized the injustice of the existing law within the area of the Metropolitan Water Board, seeing that the Board's obligations outside the County of London differ from those within it, and expressed the opinion that the same principles should operate throughout the whole of the Board's area. As regards the general system, the Committee decided to defer consideration of the matter until legislation dealing with the subject of the supply of water is proposed. The Council have adopted the report.

Darlington Gas-Works Accounts.—The abstract of accounts of the Darlington Corporation just issued states that the gas-works cost £234,064 up to March, 1916; and the year's trading resulted in a gross profit of £17,826, equal to 7 615 p.ct. on the capital invested. Ordinary consumers showed a decrease of 136 for the year; while 372 penny-in-the-slot meters were added, giving a total of 15,320 consumers. The reserve account has been reduced to £48. The net profit in aid of the rates was £7740, compared with £4425 in 1915; and 396,778,000 c.ft. were sold.

Halifax Gas-Works Accounts.—The accounts of the Halifax Corporation Gas Committee for the year ended March 31 last show a profit of £27,497, as compared with £5759 the previous year. The cost of coal was £45,544, as compared with £42,446 the year before; but residual products realized £42,238, as against £27,560 in 1914-15, leaving the net cost of coal £3306, compared with £14,885 in the previous year. The total cost of manufacture and distribution was £65,837, as against £76,858. The receipts for gas were £93,453, compared with £82,740; but the gas sent out was 844,701,000 c.ft., or 37,062,000 c.ft. less than the previous year. The gas sold amounted to 791,919,600 c.ft., a decrease of 34,775,400 c.ft.

ONE RADIANT PER FIRE PER ANNUM



A Leading Gas Authority tell us this is their **Maintenance Cost**

WHAT IS YOURS?

It will be similar if, like them, you make the - - -

"THERMO-X"

your Standard Radiant.

STRENGTH · DURABILITY and EFFICIENCY COMBINED.

John Wright & Co. Essex Works, Birmingham.

Sowerby Bridge and Benzol Recovery.—The Sowerby Bridge Gas Committee have accepted the tender of Messrs. W. C. Holmes & Co. to supply a benzol recovery plant and centrifugal washer, subject to a Class A certificate being obtained from the Ministry of Munitions, and the sanction of the Local Government Board to the borrowing of the money. The Clerk has been instructed to apply to the Board for sanction to borrow £1200 for the purpose, and to ask if the Board are prepared to make any contribution.

Popularizing Gas-Fires at Leeds.—In reply to an anonymous letter appearing in the "Yorkshire Post," Mr. W. B. Leech, the Engineer and General Manager of the Leeds Corporation Gas Department, writes to that paper: "It is true that a good many people have a grudge against gas-fires, which my experience has shown to be based upon an extraordinary misconception of their utility. My remedy is simple, and has proved in every case effective. In not one but dozens of homes in the city, I have obtained permission from sceptical occupants to instal a gas fire for trial; and though I have been ready to remove it in the event of dissatisfaction, I have not yet been asked to do so. Indeed, there have invariably been requests for further fires. At present, there is a greater demand for gas-fires than we can meet.

Belfast Gas-Workers' Generosity.—The officials and employees of the Belfast Corporation Gas-Works have given a further sum of £50 to the Ulster Volunteer Force Hospital, to endow a bed, to be named the "David Creighton" bed, after the esteemed Cashier of the Gas Department. This makes a total of £170 subscribed by the staffs and workmen towards the Institution.

Birmingham's Record Consumption.—It was reported at a meeting of the Birmingham Corporation Gas Committee, that the output of gas during the week ended Dec. 20 was practically 309,000,000 c.ft. This total constituted a record for the department; the previous maximum having been recorded in the corresponding week of 1915, when the output was 296,000,000 c.ft. The maximum daily output was recorded on Dec. 19, when it was 49,143,000 c.ft. This also was a record, being about 1,000,000 c.ft. in advance of the previous daily record. The weather during the week before Christmas was damp and foggy; and this was the main reason for the heavy consumption. From the beginning of August to the end of November, the output showed a slightly downward tendency compared with the previous year; but the foggy weather of the week preceding Christmas raised the total output considerably.

STOCK MARKET REPORT.

THE first week in the New Year opened on the Stock Exchange quite brightly and cheerfully, and, although business was almost inevitably somewhat restricted in volume, markets of almost every description showed considerable reserve of strength. Of course, the universal dominant motive power was the new War Loan, the great expectations formed in regard to which have for some time past ruled the roost. If the situation had become somewhat strained, the official announcement that the issue would be made next Thursday relieved all doubt as to the date, and left but a brief interval of uncertainty remaining as to its terms and conditions. It is, of course, outside the scope of this article to discuss these points, suffice it to say that the public in general are indulging in the most favourable anticipations regarding it.

Prominent among markets last week was the gilt-edged; nearly all the leading issues making nice advances. But the War Loan, although good for par value in applications for the coming loan, did not reach a higher figure than 98⅝. Home Rails were very firm, especially the prior charges; but buyers could not obtain all they wanted. An exception to the ruling strength was the American Market, for reasons of its own; and for reasons not of their own, Canadian issues from the association. The Foreign Market was full of strong points—French, Russian, Japanese, Chinese, and Brazilian issues being in favour. Argentine and South Africans moved irregularly. In the Miscellaneous group, there was considerable fluctuation; but textiles, cements, and banks were firm, while ships were less so.

Business in the Gas Market was a good bit better in point of activity, and the general tendency was good. Gas Light ordinary crept up steadily, and Imperial Continental made an upward leap. The Money Market was sharply touched by the closure or suspension of the issue of Exchequer Bonds, Treasury Bills, and War Expenditure Certificates, in view of the new War Loan issue; the increase in the unemployed capital bringing rates down very materially.

Bargains done for cash during the week were as follows: On Tuesday, Commercial debenture 52½, Gas Light ordinary 71⅞, 72, 72¼, 72⅜, 72½, 72¾, Imperial Continental 74½, 75, South Suburban 81½, 81⅞, ditto debenture 88, Southampton 78⅜, 79¼. On Wednesday, Gas Light ordinary 72¼, 72⅜, 72½, 72⅝, 73, Primitiva preference 62s. 6d., South Metropolitan 79, 79⅜, 80, ditto debenture 59½, 60, South Suburban 81⅛, 81¼, Southampton 79, 79¼, Wimbledon 5 p.ct. 90½, 90⅜. On Thursday, Continental Union preference 59, 60, Croydon "C" 170, 171, Gas Light ordinary 72, 72½, ditto maximum 56¼, 56½, Imperial Continental 74½, Southampton 79, 79¼. On Friday, Gas Light ordinary 72, 72¼, 72½, ditto maximum 56½, Imperial Continental 74½, 75, 75⅝, 76, South Metropolitan 79¼. On Saturday, Brentford "B" 82½, Gas Light ordinary 72, 72¼, 72¾, South Metropolitan debenture 58.

The Bank rate is 6 per cent.—as fixed on July 13.

Excellent tear-off calendars have once more come to hand from Messrs. Simon-Carves, Ltd., and Messrs. Brotherton & Co., Ltd.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue.	Share.	When Dividend.	Previous Div or Dividend and Bonus.	Last Dividend.	NAME.	Closing Prices. July 30, 1914.	Present Prices.	Lowest and Highest Prices of Bargains.
£			p.c.					
175,472	Stk.	Mar. 10	4	4%	Aldershot 4 p.c. Pref.	..	65—70	..
1,551,868	,,	April 8	2½	5⅛%	Alliance & Dublin Ord.	59—64	62—64	..
574,000	,,	July 10	4	4%	Do. 4 p.c. Deb.	76—79	60—65	..
280,000	5	April 29	7½	4/6	Bombay, Ltd.	5⅞—6⅜	5—5½	..
50,000	10	Feb. 26	16	15/-	Bourne- (10 p.c.	29—30	25—27	..
383,110	10	,,	7	7/-	mouth Gas (B 7 p.c.	15—15⅛	11—11½	..
115,000	10	,,	6	6/-	and Water (Pref. 6 p.c.	13½—14	9½—10	..
159,740	—	—	—	4%	(4 p.c. Deb.	..	71—73	..
992,045	Stk.	Feb. 26	†14	55/-	Brentford A Consolid.	261—266	85—87	..
734,920	,,	,,	†11	53/9	Do. B New	204—209	82—84	83½
55,000	,,	,,	5	5%	Do. 5 p.c. Pref.	109—111	85—90	..
221,400	,,	June 11	4	4%	Do. 4 p.c. Deb.	91—93	67—69	..
217,380	,,	Feb. 26	11	10⅞%	Brighton & Hove Orig.	208—213	160—165	..
244,200	,,	,,	8	7⅞%	Do. A Ord. Stk.	154—159	115—120	..
530,000	20	Mar. 26	12½	22/6	British	44—45	34—35	..
120,000	Stk.	June 26	4	4%	Do. 4 p.c. Deb. Stk.	88—90	66—68	..
245,771	,,	,,	4	4%	Buenos Ayres 4 p.c. Deb.	85—87	58—63	..
100,000	10	—	—	—	Cape Town & Dis., Ltd.	1½—2½	1½—1⅞	..
100,000	10	—	—	4⅛%	Do. 4½ p.c. Pref.	4—6	4⅛—5	..
100,000	Stk.	June 26	4½	4⅛%	Do. 4½ p.c. Deb. Stk.	70—75	58—63	..
157,150	,,	Feb. 25	5	5%	Chester 5 p.c. Ord.	108—110	82—84	..
1,513,280	,,	Feb. 12	5/9/4	49/4	Commercial 4 p.c. Stk.	105—108	72—74	..
560 000	,,	,,	5½	46/8	Do. 3½ p.c. do.	103—105	68—70	..
475,000	,,	June 11	3	3%	Do. 3 p.c. Deb. Stk.	69½—71½	53—54	52½
800,000	,,	,,	4	—	Continental Union Ltd.	76—79	36—38	..
200,000	,,	,,	7	—	Do. 7 p.c. Pref.	115—118	53—60	59—60
278,400	—	—	—	11⅛%	Croydon B and C 7 p.c.,	..	175—185	170—171
—	—	—	—	10%	Do. E	..	..	..
492,270	Stk.	—	6	5⅛%	Derby Con. Stk.	123—125	100—105	..
55,000	,,	—	4	4%	Do. Deb. Stk.	102—104	80—83	..
1,032,180	10	July 29	10	7/6	European, Ltd.	17½—18	11—12	..
16,313 430	Stk.	Feb. 10	4/17/4	42/-	4 p.c. Ord.	98—102	71—73	71½—73
2,600,000	,,	,,	3½	3½%	Gas 3½ p.c. max.	76—79	55—58	56½—56½
4,062,235	,,	,,	4	4%	Light 4 p.c. Con. Pref.	96—99	69—71	..
4,674 850	,,	June 11	3	3%	and 3 p.c. Con. Deb.	72½—74½	56—58	..
130,030	,,	,,	10	10%	Coke 10 p.c. Bonds	..	..	..
258,740	,,	Mar. 12	5	4½%	Hastings & St. L. 3½ p.c.	87—89	78—83	..
70.000	10	April 29	11	6%	Hongkong & China, Ltd.	16½—16⅝	8—9	..
26,600	—	—	—	9½%	Hornsey 7 p.c.	..	125—135	..
131,000	Stk.	Mar. 12	7⅞	7⅜%	Ilford A and C.	151—154	105—110	..
65,780	,,	,,	6⅝	5⅞%	Do. B	115—118	92—97	..
65,500	,,	June 26	4	4%	Do. 4 p.c. Deb.	92—94	71—74	..
4,940,000	,,	May 14	9	4½%	Imperial Continental	150—160	73—78	74½—76
1,235,000	,,	Feb. 12	3½	3½%	Do. 3½ p.c. Deb. Red.	84—86	65—67	..
235,242	,,	Mar. 12	6½	6½%	Lea Bridge Ord. 5 p.c.	119—121	87—92	..
2,498,905	,,	Feb. 26	10	5%	Liverpool 5 p.c. Ord. A	211—213	85—87	..
					B	146—148		
306,083	,,	June 26	4	4%	Do. 4 p.c. Pr. Deb. Stk.	..	74—76	..
75,000	5	June 11	6	2/-	Malta & Mediterranean	4½—4⅝	3⅞—4⅛	..
250,000	100	April 1	4½	4½%	Met. of Melbourne 4½ p.c. Deb.	99—101	89—93	..
541,920	20	May 28	4	6/-	Monte Video, Ltd.	11⅛—12	8½—8⅝	..
1,875,892	Stk.	July 29	4½	4½%	Newcastle&Gatsh'dCon.	98½—99½	79—80	..
529,705	,,	June 26	3½	3½%	Do. 3½ p.c. Deb.	82—83	75—77	..
55,940	10	Feb. 26	7.14/0	7/8½	North Middlesex 7 p.c.	14—15	10½—11½	..
300,000	Stk.	May 14	8	8%	Oriental, Ltd.	117—122	104—106	..
60,000	5	Mar. 26	10	1/-	Ottoman, Ltd.	7½—7⅝	2—3	..
60,000	50	Feb. 26	13	12½%	Portsea, Island B	128—131	95—100	..
100,000	50	,,	12	11%	Do. C	118—121	88—93	..
52,000	50	,,	10	9%	Do. D	..	..	..
249,980	5	April 29	8	—	Primitiva Ord.	5⅛—6	2—2½	..
499,960	5	June 26	5	2/6	Do. 5 p.c. Pref.	4⅝—5	3—3½	62/6
521,600	100	June 2	4	4%	Do. 4 p.c. Deb.	91—93	78—80	..
—	—	—	—	4%	Do. ,, ,, 1911	..	..	..
346,198	Stk.	June 26	4	4%	River Plate 4 p.c. Deb.	85—87	61—67	..
150,000	10	May 14	6	6/-	San Paulo 6 p.c. Pref.	10⅜—11	8—8½	..
125,000	50	July 1	5	5%	(5 p.c. Deb.	47—49	42—44*	..
135,000	Stk.	Mar. 12	10	10%	Sheffield A	223—224	188—192	..
203,984	,,	,,	10	10%	Do. B	222—224	188—192	..
523 500	,,	,,	10	10%	Do. C	220—222	188—190	..
90,000	10	May 28	9	6/-	South African.	10⅛—11⅛	..	..
6,609,895	Stk.	Feb. 10	5/4/0	44/-	South Met. 4 p.c. Ord.	111—113	78—80	79—80
1,895,445	,,	July 10	3	3%	Do. 3 p.c. Deb.	72⅛—74½	58—60	58—60
221,820	,,	Feb. 26	8½	8%	South Shields Con. Stk.	157—159	145—147	..
952,795	,,	,,	6	48/4	S'th Suburb'n Ord. 5 p.c.	114—116	80—82	..
60,000	,,	,,	5	5%	Do. 5 p.c. Pref.	110—112	79—81	..
135,000	—	—	—	48/4	Do. West Kent	..	..	..
187,558	Stk.	June 26	5	5%	Do. 5 p.c. Deb. Stk.	116—118	88—90	..
647,740	,,	May 14	5	5%	Southampton Ord.	99—102	77—79	78½—79½
120,000	,,	Feb. 12	7½	7½%	Tottenham A 5 p.c.	135—138	120—123	..
782,275	,,	,,	6	5⅞%	District B 3½ p.c.	115—117	90 - 92	..
181,255	,,	June 26	4	4%	4 p.c. Deb.	87—89	65—67	..
182.380	10	Dec. 30	5	—	Tuscan, Ltd.	5—6	1—2	..
149,900	10	July 1	5	5%	Do. 5 p.c. Deb. Red.	94—95	60—65*	..
235,476	Stk.	Mar. 12	5	5%	Tynemouth 5 p.c. max.	103⅜—109½	91—92	..
					Wandsworth, Wimbledon, and Epsom—			
30,000	,,	Feb. 26	8⅜	78/9	Wandsworth A 5 p.c.	151—156	117—122	..
275 636	,,	,,	6¼	63/9	Do. B 3½ p.c.	129—134	101—103	..
108,075	,,	,,	5/17/3	55/1½	Do. C 3½ p.c.	110—115	88—93	..
352,000	,,	,,	6¼	57/6	Wimbledon 5 p.c.	117—122	90—95	90½—90⅝
98,000	,,	,,	6⅜	63/9	Epsom 5 p.c.	121—126	98—103	..
88,416	,,	June 26	3	3%	3 p.c. Deb. Stk.	66—69	51—54	..

* Ex. div, † Paid on Old 10 p.c. and 7 p.c. Standard Stocks.

Stealing Gas-Fittings at Rhyl.—William F. Cookson has been sentenced to eighteen months' hard labour at the Flintshire Sessions, for stealing gas-brackets at Rhyl. Representing himself to be in the army, he endeavoured to obtain possession of a private house, for the purpose, he said, of using it as a boarding-house for officers. As his references proved unsatisfactory, the agent refused to allow him to have the house; but during the agent's absence, prisoner went to his office and persuaded the office lad to let him have the keys. He then proceeded to the residence, and took the gas-brackets he found there, and sold them at Rhyl. He was subsequently arrested on another charge; and the keys of the house were found in his possession.

Public Lighting of Salford.—Mr. Steele referred to the lighting of the streets at last week's meeting of the Salford Town Council, and asked the Chairman of the Lighting Committee to state what sort of protection was going to be provided for the public in case of fog. Alderman Hulton, replying, said that the Chief Constable was not willing to relax the powers he possessed as to increasing the lighting. Up to the time of the war, 7489 lamps were lighted in the borough; while at present there were 2583, the bulk of which must, by order of the military authorities, be turned out three hours after sunset. During the prevalence of fog, the Chief Constable allowed the lamps to be kept alight until 11 o'clock at night. Answering observations by several members of the Council, the Alderman added that he would again talk over the matter with the Chief Constable.

The Hackney Electricity Charges Case.—At the last meeting of the Woolwich Borough Council, the General Purposes Committee reported having had under consideration a memorandum from the Electricity Committee, in connection with the action which is being brought by the Gas Light and Coke Company against the Hackney Borough Council in the matter of alleged preferential charges for electricity. The Electricity Committee are of opinion that the Council should agree to bear an equitable proportion of the costs involved in the action, but that the Council should request the Hackney Council and the Incorporated Municipal Electrical Association (who are taking great interest in the matter) to make representation to the Ministry of Munitions, with a view to proceedings being held in abeyance during the period of the war. The General Purposes Committee agree with this opinion, and think it is in the Council's interest that action should be taken on these lines. A recommendation to this effect was adopted.

Street Lighting Restrictions and Economy.—An anonymous correspondent of one of the Birmingham papers has ideas of his own on the question of the wisdom, from the point of view of economy, of restricting street lighting. The heavy consumption of gas recorded in the city need not, he says, occasion any surprise. When Birmingham was placed in complete darkness, the arguments brought forward were intended to demonstrate that the lighting restrictions had quite as much to do with the appeal for national economy as precautions against air raids; but "it was obvious from the outset that, whatever gas might be saved in street lighting, would be enormously increased by private consumption." In the road where he lives, there are six public lamps which are now never lit, and about 250 houses. Very few people in these houses can now leave their homes after dark; and the consequence is that in them there are probably burning for several hours each night at least 500 gas-jets, which would not be if the six street-lamps were lit. And this, he declares, is merely an instance of what is taking place in every road and street in the city. So keenly does he feel on the subject, that he recently wrote to the Home Secretary pointing out "this wicked waste of the nation's resources, and has received a reply stating that the matter will receive his closest and immediate attention." This increased consumption of gas is, the writer concludes, but one aspect of the lighting "restriction" order, "the most colossal blunder ever inflicted upon a community."

Automatic Lamp Controllers at Leven.—An installation of forty "A. & M." patent pressure-wave automatic controllers has been successfully put into operation in connection with the public lamps at Leven (Fife), by arrangement with the police authorities for the Fife County Council. A boosting plant, whereby the pressure is raised by means of a jet of steam, has recently been installed at the gas-works by Mr. P. L. Readdie (the Engineer and Manager).

Bilston Gas Company.—The satisfactory nature of the accounts was commented upon by the Chairman (Mr. Harold Holcroft) at the annual meeting of the Bilston Gas Company. He said that, since the beginning of the war, the Directors had avoided any increase in the price of gas, with the exception of 1d.; and this was a fact of which the Directors had reason to be proud. The profit and loss account, after paying the usual interim dividends, showed a credit balance of £17,004; and out of this it was decided to pay further dividends of 5s. 6d. per share on the "A" shares and 4s. per share on the "B" shares (both less tax)—making 11s. and 8s. per share (less tax) respectively for the year. This will leave a balance of £14,990.

A Warning at Drogheda.—Mr. E. P. M'Carron, Local Government Board Auditor, reports, in regard to the Drogheda Gas-Works, an adverse balance of £145 odd; observing also that the sale prices of coke have been unwarrantably low. Members of the Corporation and of the Gas Committee, some of whom are identified with the bakery trade, are alleged by the Auditor to be extensive purchasers at these low rates; and they are asked to realize that they have been "availing themselves of improper prices, to their own advantage, and to the detriment of other ratepayers and gas consumers." They had, said Mr. M'Carron, laid themselves open to proceedings for breach of trust, and had disqualified themselves from holding office. Alderman Elcock suggested, at a meeting of the Corporation, that they should ignore the Auditor's "impertinence." The Corporation took no action.

The price of gas in Londonderry has recently been advanced 2d. per 1000 c.ft.

The Belfast Chamber of Commerce, in a resolution in favour of the continuance of the Summer Time Act in Ireland, point out that in the city the gas consumption was, under the new time, 5¼ p.ct. less than in 1915.

At an inquest at Jarrow-on-Tyne, last week, on Joseph Connolly, a labourer, who was killed while employed at the Jarrow Gas-Works, it was stated that he was apparently caught and taken round by wheels which carried a chain. A medical man said death was due to shock following extensive mutilation.

A verdict of "Death by misadventure" was returned at an inquest on the body of a Greek, who was suffocated by gas in Charlotte Street, W. It was thought that he had gone away for a holiday; but the landlord looked through the keyhole, and when the door was forced the man was lying on the bed dead. He was supplied with gas from a prepayment meter, which other tenants shared; and it was pointed out that when the others put pennies in the slot his tap might have been turned on, thus allowing gas to escape through the jet.

At a meeting of the Dudley Town Council last Tuesday, the Mayor (Mr. S. C. Lloyd) mentioned that the Streets and Lighting Committee had agreed upon a system of increased street lighting, and had referred it to a Sub-Committee to bring forward a practical scheme. At Wednesbury, the General Purposes Committee reported having received a petition signed by over 1000 persons, asking for some modified form of street lighting. They stated that they had acceded to the views of the petitioners by arranging for certain shaded gas-lamps to be re-lighted at dangerous corners. In both towns satisfaction is felt at the announcements made.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

HEAT EXPERT. No. 6262.
ENGINEER AND MANAGER. Swindon Gas Company. Applications by Jan. 20.
ASSISTANT. Keighley Gas Department. Application by Jan. 17.
WORKING MANAGER AND FITTER. No. 6259.
FOREMEN. No. 6263.
GAS-FITTERS. Bolton Corporation.
SERVICE LAYER. Ormskirk Gas-Works.

Agency Wanted (France).

G. Margueritte, 20, Rue de Grammont, Paris.

Plant, &c., for Sale.

AMMONIACAL LIQUOR STILL. Robin Hood Coke Works, near Wakefield.
STATION GOVERNORS. Tipton Gas Department.

Plant, &c., Wanted.

SULPHATE STILL. No. 6255.

Tank Waggons Wanted (Hire or Purchase).

No. 6251.

Carbon Wanted.

No. 6192.
No. 6261.

Mortgages.

WORTHING GASLIGHT AND COKE COMPANY. Particulars of Messrs. A. & W. Richards.

Meeting.

COMMERCIAL GAS COMPANY. Cannon Street Hotel. Feb. 15. Twelve o'clock.

TENDERS FOR

Retort Setting, &c.

LIMERICK GAS DEPARTMENT. Tenders by Jan. 15.

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E. GEO. VINCE, Secretary.

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Gas-Works, Tipton.

FOR SALE—the following Tanks:—

One 21 ft. 6 in. diam. × 10 ft. deep ¼ in. plates. Could be made deeper and covered in if required.

Two	Egg-end	BOILER	TANKS,	6 ft. × 34 ft.
One	,,	,,	,,	7 ft. × 30 ft.
One	,,	,,	,,	5½ ft. × 34½ ft.
One	,,	,,	,,	5 ft. × 32 ft.
One	,,	,,	,,	5 ft. × 35 ft.
One	,,	,,	,,	4½ ft. × 18 ft.
One	Flat-end	BOILER	TANK,	7 ft. × 30 ft.
Two	,,	,,	,,	7½ ft. × 28 ft.
One	,,	,,	,,	6 ft. × 26 ft.
One	,,	,,	,,	5 ft. × 30 ft.
One	,,	,,	,,	4 ft. 10 in. × 16 ft.
One	,,	,,	,,	4 ft. 4 in. × 15 ft.

PUMPS, ENGINES, GASHOLDERS, PURIFIERS, CONDENSERS, EXHAUSTERS, SCRUBBERS, &c., in stock.

FIRTH BLAKELEY, SONS, AND CO., LTD., CHURCH FENTON, LEEDS.